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SOUTH DAKOTA

AGRICULTURAL COLLEGE

AND

EXPERIMENT STATION

BROOKINGS, S. D.

BULLETIN NO. 27.

NOVEMBER, 1891.

Department of Chemistry.

The Sugar Beet in South Dakota.

DUTCHER & BREED, BROOKINGS.

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THE SUGAR BEET IN SOUTH DAKOTA.

JAMES H. SHEPARD, Chemist.

MOTHER BEETS FOR SEED.—At the close of the season last year, a number of sugar beets of the different varieties grown on the college farm were carefully selected and stored in the root cellar. From these beets it was proposed to raise pedigreed seed. Accordingly in the following May 11-14, these beets were subjected one by one to analysis. By means of a common three-fourths inch bit, a diagonal hole was bored from a point as low as possible on the root and extending upward towards the crown. The borings which were obtained were used in the analysis. The auger holes were plugged with moist clay as soon as the boring was completed. Since the purity coefficient for all the beets had previously been found satisfactory and especially so in the case of those beets showing a high per cent. of sugar it was only necessary to determine the sugar content. This was accomplished by the method of Tollens-Rapp-Degener. Under the circumstances this method would give results rather lower than the actual sugar content, since it was found to be rather difficult so to regulate the pressure on the bit as to give equally and sufficiently thin sections or chips. But even under these circumstances which were somewhat unfavorable and which were rendered more so by the long time the beets had been stored before they were analyzed, it was determined to save no beet for planting that should not show 15 per cent. and over of sugar in the beet. It is evident from the manner of conducting the experiment that beets of good keeping quality and at the same time rich in sugar were secured. None of the samples analyzed had wilted.

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The first beets analyzed were Dieppe's Klein Wanzlebener. Eight beets were taken with results as tabulated below:

Sta. No.	Wt. Grams	Sugar in Beet
76	669	13.82
77	582	14.91
78	547	14.51
79	470	13.22
80	425	15.70
81	368	17.40
82	322	15.50
83	251	13.95

Of these only Nos. 80, 81 and 82 were planted.

The next variety analyzed was Simon Legrand's White Improved. Of these beets seven were tested with the following results:

Sta. No.	Wt. Grams	Sugar in Beet
84	497	14.11
85	521	15.11
86	429	15.11
87	385	15.11
88	373	11.53
89	312	12.13
90	293	15.61

Station Numbers 85, 86, 87 and 90 were planted.

Six beets, variety, Pajaro Valley, were next analyzed with the following results:

Sta. No.	Wt. Grams	Sugar in Beet
91	1267	9.94
92	651	11.83
93	354	13.52
94	317	14.02
95	304	15.31
96	297	15.51

The last two only were planted.

Florimond Desprez's Richest were then analyzed with the following results:

Sta. No.	Wt. Grams	Sugar in Beet
97	642	11.23
98	531	12.52
99	512	9.54
100	500	10.44
101	462	12.92
102	351	10.92
103	349	10.93

All these beets were rejected as none of them came up to the requirements.

Bulteau Desprez's Richest was the next variety and seven beets were examined with results as follows:

Sta. No.	Wt. Grams	Sugar In Beet
104	976	12.62
105	619	13.92
106	477	15.11
107	386	14.02
108	336	15.61
109	328	14.41
110	384	13.32

Nos. 106 and 108 were planted,

Seven beets of the variety Dieppe's Vilmorin were lastly analyzed with results as follows:

Sta No.	Wt. Grams	Sugar in Beet
111	327	12.42
112	268	14.91
113	318	Lost
114	312	17.01
115	298	14.71
116	303	16.31
117	316	16.21

Nos. 114, 116 and 117 were planted. On the whole the beets of this variety seemed to be better keepers than any of the preceding.

The mother beets after planting made new tops and threw out flower stalks in great luxuriance. From the small number planted a good yield of seed was obtained. This seed will be planted next May and from the beets raised it is expected that in the following year a sufficient quantity of home grown pedigreed seed will be raised to enable the Station to distribute a fair number of packages for trial. Before leaving this topic it might be well to state that the different varieties of mother beets were planted so far apart that there was no possibility of cross fertilization.

And farther, it will be a good plan for farmers who have had beets of high sugar content (as shown by the analysis this year) to select rather smallish, perfect beets and plant them for seed. Large or deformed beets must not be used for this purpose.

THE SUGAR BEET CROP FOR 1891.

Last spring about one thousand samples of seed were distributed throughout the state. Between seven and eight hundred were sent from this Station. The seed distributed was obtained from various sources, some coming from the Department of Agriculture, and some, variety Desprez, coming from the Oxnard company. In addition to these, various parties throughout the state obtained seed direct from Germany.

In making the report for this season it was deemed best to divide the state into different regions which have somewhat similar climatic conditions. But when the large area of the state is taken into consideration; and when it is remembered that a few local showers just at the right time, or at the wrong time, would greatly influence the growth and development of the sugar beet, it will become evident that even in the regions marked out much variation may be expected.

THE BIG SIOUX VALLEY AND EASTERN REGION embraces all that portion of the state east of the eastern water shed of the James river.

THE JAMES RIVER VALLEY REGION is a well marked district most of which is situated over the artesian basin in South Dakota. This region has many advantages for sugar beet culture.

THE MISSOURI RIVER REGION extends from the western water shed of the James river to the Missouri river. The tier of counties west of the river are but sparsely inhabited toward the northern portion of the state.

THE BLACK HILLS REGION, as is well known, embraces the rich mining regions of western South Dakota. There are many fertile valleys and level plateaus throughout this region where farming is carried on; and it is from these places that the samples of this year have come.

Under each region the report is given by counties. Under the circumstances it was not possible to give averages for each county. It would evidently be unjust to strike averages when some samples were analyzed on trial and found to be immature and afterwards analyzed again. Or again it would not be proper to average a fair sample with a sample that was manifestly not a proper sample at all. Consequently a complete history of each sample is given so far as obtainable. It will be noticed that some of the poorest samples are not from what is now strictly considered to be sugar beet seed.

RESULTS OF THE SEASON'S WORK.—In all two hundred and sixty-three analyses have been made this year. These analyses have been carefully executed by more laborious methods than usually employed. The marc has been determined and the results show that there is a wide variation from the marc usually assumed, five per cent., in more rapid methods, The ash was obtained by incineration with sulphuric acid. One tenth was deducted to allow for excess of weight of sulphates over carbonates. The sugar in the beet was determined by Scheibler's process. And from this factor together with the marc the sugar in the juice was calculated. The Degree Brix was taken with an accurate spindle, applying corrections for variations of temperature. This method was controlled by obtaining the total solids by eveporation with sand. The results were practically identical.

Without attempting to give averages a comparative statement may be made which will be found useful as tending to throw light upon the effect of different methods of cultivation, etc., as effecting the sugar content of the beet.

Of the 263 analyses, 55 show under 10 per cent. sugar in the beet; of these 13 show 10 per cent. and over of sugar in the juice. 84 show between 10 and 12 per cent. sngar in the beet; of these 34 show 12 per cent. and over of sugar in the juice, and are consequently of marketable value; 79 show over 12 per cent. and under 15 per cent. sugar in the beet, of these 41 show over 13 per cent. sugar in the beet; 45 show over 15 per. cent. sugar in the beet, and of these 8 show over 17 and 2 show over 18 per cent. sugar in the beet.

METHODS OF CULTIVATION, ETC.—A careful examination of the analyses giving poor returns will clearly exhonorate soil and climate from the responsibility of the low per cent. of sugar. It will be found that the poor samples are due to some one of or to a combination of several of the following causes:

1. A bad selection of ground. Low black bottom land was chosen when a higher and lighter soil would have been better.

2. The direct application of barn yard manure. Land should be used that has not been manured for one or two years.

3. Shallow plowing. The land should be plowed at least twelve inches deep. If a subsoil plow is at hand, then ten inches with four inches subsoiling will give better results. The condition of some of the samples received shows the effect of this shallow plowing by the distorted shapes and numerous tap roots of the beets.

4. The seed was planted too late and the beets were harvested too early. The seeds should be sown as soon in May as danger from frost is over, say from the 1st to the 10th. When the season is late as it was this year the beets do not ripen until the very last of October or the first of November. If the beets get a late start in the spring they should be left in the ground as long as possible. They will stand quite a hard frost without injury when standing as they grew. Soaking the seed will hasten germination.

5. The beets were too thin on the ground. Rows varying from 16 inches to eight feet are reported. The rule is, make the rows as close together as possible in soil as rich as that of this state. Also have the beets stand closely together in the row. This prevents the beets from growing too large and gives a better purity coefficient. Probably rows 22 to 24 inches with beets from five to six inches will give the best results obtainable on a commercial scale in our state. The rows well might be only sixteen inches were it not that this would prevent cultivation with horse cultivator. It was not always the farmer's fault that the beets were too thin on the ground, as cutworms destroyed some plots almost completely.

6. Large beets were sent as samples instead of average sized ones as directed. It is a complaint that comes from all parts of the country where sugar beet experiments are now going on that it is hard to get the average farmer to believe that large beets are not best for sugar making. Even where factories are located the same complaint is heard. But it is a well settled fact that LARGE beets and a LOW sugar content always go together. Monstrous beets have been sent to the Station this year in direct violation of instructions.

WORK FOR NEXT YEAR.--The Station Council has decided that the experiments with sugar beets should be continued another year. Also that four hundred samples of seed should be sent out, and that the necessary funds be apportioned to the Department of Chemistry for carrying on the work.

The work here is so far advanced that nothing further can be gained by haphazard tests in any direction. The work of this season shows that good beets for the purpose of sugar manufacture can be raised with good cultivation, and that poor beets unfit for that purpose can be grown by poor cultivation.

Consequently seed will be sent only to such as will promise to give necessary attention to cultivation. What would be more desirable would be that the distribution should be made to those localities where the people are looking forward to the erection of sugar factories. In such cases, by the active co-operation of a local committee, which could see that proper persons are selected and instructed HOW to grow the beets, and by instructions that will be sent out from this Station, actual results can be obtained that will compare with those that would be obtained were the factory in operation. The Chemist of this station will be ready at all times to give such aid as may be desired by the grower. Personal visits by him to localities where many samples are placed and the taking of test samples for analysis before the main samples are taken, etc., etc., would be of advantage, so that the reports of next year should not include immature or unfit specimens. All this would insure better results than can be reached any other way.

All correspondence in relation to this work should be addressed to Jas. H. Shepard, Chemist, Brookings, S. D.

The following pages are devoted to a history of the experiments made this year.

THE BIG SIOUX VALLEY AND EASTERN REGION.

MARSHALL COUNTY.

Three samples were received from this county. The beets were large and had grown vigorously. In all twenty-three samples of seed were distributed throughout the county.

Sta. No. 223 came from C. N. Cooper, Britton township. Stable manure was used and beets were hoed. The beets were planted too late and were not thick enough upon the ground; and the manure was also a disadvantage; stand of crop was good.

Sta. No. 276 was from M. L. Babcock, Heckman Township. No fertilizers were used and the beets were both cultivated and hoed. The stand was only 40 per cent. owing to drought. These beets were not thick enough upon the ground.

Sta. No. 287 came from L. O. Harrington, Pleasant Valley township. Well rotted stable manure was used and the beets were hoed. The stand of crop was fair. This was the best sample from Marshall county.

The following tables will show the data given and the analyses of the samples:

Station No.	Variety	Planted	Harvested	Rows	Between Beets	Tons per Acre	Soil
223	Desprez	June 1	Oct. 17	30 in	12 in	24.9	Sandy Loam
276	Desprez	May 21	Oct. 24	24 in	24 in	7.2	Common Prairie
287	Desprez	May 10 15 30	Oct. 26	24 in	6 in	9.3	Black Loam

ANALYSES:

Sta. No.	No. beets analyzed	Av wt. grams	Sugar in beet	Sugar in juice.	Ash in juice	Marc	Degree Brix	Purity coefficient
223	6	1224	9.65	10.05	1.5[illegible]	4.01	14.40	69.09
276	5	943	11.00	11.51	1.59	4.42	16.50	70.00
287	6	884	12.10	12.72	1.80	4.89	18.10	70.00

A blank with report was also received from E. M. Ireland, Newport township, but his sample failed to reach the Station.

He reports a fair stand of crop with a yield of ten tons per acre

ROBERTS COUNTY.

Three samples were received from this county. In all seven samples of seed were sent out to the county from the Station.

Sta. No. 246 was grown by J. T. Stowell of Garfield township. The ground was well manured three years ago and the last crop was cabbage. The ground was plowed 11 inches deep in May, and well harrowed. Beets were cultivated by hand and weeded June 12th to 18th; thinned June 30th and hoed July 30th and Aug. 5. Although the analysis gave good results, nevertheless it is probable that if the beets had been left standing in the ground two weeks longer there would have been a material increase in the per cent. of sugar. Mr. Stowell writes that he has raised sugar beets successfully for the last two years.

Sta. No. 293 came from A. H. Greene, Lake township. He used no fertilizer and cultivated by hand. Frost injured the sample July 24. Steand of crop, 75 per cent.

Sta. No. 321 was grown be W. T. VanDerwarker, Lockwood township. He used no fertilizer and cultivated with hoe.

The following tables complete the reports on these samples:

Station No.	Variety	Planted	Harvested	Rows—inches	Beets in row. inches	Tons per acre	Soil
246	Klein Wanzlebener..	May 5	Oct. 16	18	5	10.5	Black loam
293	Desprez	May 20	Oct. 28	16	6	33.0	" "
321	Desprez	May 20	Oct. 15	24	10	38.0	Clay bottom land

ANALYSES:

Sta. No.	No. beets analyzed	Av. wt. grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
246	6	580	13·80	14.48	1.42	4.72	19.40	74.64
293	3	625	9.60	10.02	1.28	4.23	13.10	76.50
321	3	1330	11.70	12.24	1.62	4.43	14.20	86.20

A letter was received from J. E. Englund who did not send a sample because the beets were not so large as he thought they should be. He states that they only averaged about twelve ounces each and attributes their small size to dry weather. In all probability had he sent in a mature sample a higher per cent. of sugar would have been obtained than from any other sample from that county. He also reports similar results from a near neighbor.

DAY COUNTY.

Twenty seven samples of seeds were sent to this county last spring. Eight samples of beets have been received and four reports without samples have been sent in.

Sta. No. 170 came from Frank Allen, Homer township. No fertilizers were used and the stand was poor and irregular. The seed was sown with a shoe drill. Plowed once and then kept clean with the hoe. The beets were not harvested.

Sta. No. 197 was from Eli Stearns, Homer township. No fertilizer used and one fourth stand of crop reported. The beets were hoed once. The beets were altogether too far apart.

Sta. No. 218 came from Samuel Resseguie, Scotland township. No fertilizer and good stand are reported. The beets were cultivated with horse cultivator.

Sta. No. 227 was from J. D. Martin, Homer township. The beets were hoed once, had no fertilizer and gave one fourth stand.

Sta. No. 265 is from W. R. Lawrence, Farrington township. The beets were not planted in rows but were sown broadcast, consequently they were not cultivated at all.

Sta. No. 269 comes from A. J. Miles, Homer township. He reports a good stand, used no fertilizer, plowed the ground deep and cultivated the beets with a hoe.

Sta. No. 347 was from W. E. Metherell, Homer township. No fertilizer, fair yield and cultivated with hoe.

Sta. No. 210 is an unindentified sample and was analyzed by mistake; it came from Webster.

The following tables complete the reports:

Station No	Variety	Planted	Harvested	Rows—inches	Beets in row—inches	Tons per acre	Soil
170	Desprez	May 21	Oct 15	24	6-24	.....	Sandy Loam
197	Desprez	June	Oct 13	36	20	8	Sandy Loam
218	Desprez	May 18	Oct 15	36	6	12	Black Loam
227	Desprez	May 22	Oct 8	18	8	10	Sandy Loam
265	Vilmorin (?)	May 25	Oct 11	...	....	16	Black Loam
269	....	Apr. 28	Oct 13	24	6-8	18	Black Loam
347	Desprez	May 16	Oct 15	20	5	28	Black Loam

ANALYSES:

Sta No	No beets analyzed	Av. wt. grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
170	6	784	10.60	11.06	1.27	4.21	15.50	71.35
197	6	995	10.30	10.75	1.90	3.86	15.60	68.91
218	6	738	7.10	7.38	1.58	3.60	12.20	60.50
227	6	981	14.90	15.61	1.39	4.54	18.40	84.29
265	6	701	12.45	13.08	1.08	4.61	16.50	73.21
269	6	501	12.75	13.42	1.69	5.03	18.30	73.33
347	6	612	13.70	14.48	1.81	5.49	19.40	74.64
210	6	315	12.10	12.70	1.16	4.75	16.60	76.51
379	6	485	14.45	15.20	....	....	20.00	76.00

L. W. Lewis of Scotland township, reports a good stand with a yield of about 13.5 tons, but his sample. Sta. No. 379, came too late for complete analysis. W. S. Dart of Independence township reports good stand, but his sample was somehow lost. C. A. Bonner, Homer township, reports that his seed failed to germinate. E. E. Flint of the same township reports his plants destroyed by stock.

GRANT COUNTY.

Eight samples of seed was sent out to this county from the Station, and Henry S. Volkmar of the Grant County Review writes that he distributed two hundred samples. All told, thirteen samples have been analyzed from Grant county.

Sta. No. 140 was grown by E. C. Clark of Alben township. No fertilizers were used and two-thirds stand crop is reported. The beets were cultivated with horse cultivator and hoe.

Sta. No. 153 was raised by Thomas Street of Revillo, Adams township. A fair stand is reported but all told a light crop owing to excessive drought. He does not think that over one and one half inches of rain fell after June 20. The beets were cultivated by horse cultivator and hoed and weeded by hand. The results are not encouraging.

The remaining eleven samples were collected by Mr. Volkmar and forwarded to the Station. He writes: "I distributed 200 samples, but the farmers have either been too busy or too negligent to bring in samples. However, I think what I send you will be sufficient for your purpose." It is a pity that more samples from this county were not forthcoming. Many rank good and some of them are exceptionally fine.

Sta. No. 350 was raise by Frank Robel, Alban township. The land was high rolling prairie. No fertilizers were used. The land had been planted to peas and had grown up to weeds. The weeds were killed and then the beets were sown. The stand was reported good but insufficient data were given whereby the yield per acre could be obtained.

Sta. No 351 was raised by William Dolly in the city of Milbank. The beets were cultivated with a hoe. No other data are given.

Sta. No. 352 was raised by John C. Reeve, Melrose township. The beets were hoed three times, and the stand was good.

Sta. No. 353 was grown by John Lindberg, Big Stone township. Manure was used and beets were cultivated by hoe.

Sta. No. 354 was grown by Harvey T. Rawson, Melrose township.

Sta. No. 355 was grown by John Martens, Melrose township. The land was plowed the previous fall and again on May 29th, when the seed were immediately sown while the ground was yet moist. The beets were cultivated three times.

Sta. No. 356 was grown by Harvey T. Rawson, Melrose township, on what he calls "fair kind of ground."

Sta. No. 357 was grown by Geo. Jenkins, Grant Centre township. The beets were tilled by means of a cultivator. This is the best sample from the county and as good as any in the state. More explicit information concerning this sample would have been particularly acceptable.

Sta. No. 358 was grown by F. A. Russell, Alban township.

Sta. No. 360 was grown by N. Bower, Grant Centre township. The land which is described as good corn land with a little sand had been plowed for corn to a depth of about eight inches. The beets were first cultivated with cultivator and afterwards hoed three times. Ground was moist.

Sta. No. 364 was raised by John Tillman, Melrose township. Manure was used and a fine stand was obtained. The beets were well hoed, thinned and kept free from weeds.

The following tables give all the remaining data and complete the report:

Station No.	Variety	Planted	Harvested	Rows—inches	Beets in row—inches.	Tons per acre	Soil
140	Desprez	May 15	Oct 15	26	5	12	Low bottom land
153	Desprez	May 15	Oct 10	30	8	3	Black loam
350	German	June 14	Oct 15	....	15	......	Highland loam
351	German	June 1	Nov 10	....	....	......	....
352	Desprez	May 25	Oct 24	24	8	14	Black loam
353	German	May 15	Oct 28	15	6	40	Sandy loam
354	German	June 12	Oct 25	....	....	7.5	Fair
355	German	May 29	Oct 20	18	12	19	Low sandy
356	Desprez	June 12	Oct 25	....	....	7	Fair
357	German	May 20	Oct 20	36	4	11	Loam
358	German	May 13	Oct 19	.. .	....	......	....
360	German	May 18	Oct 28	24	6	30	Sandy
364	German	May 20	Nov 3	24	16	8.6	Bottom land

ANALYSES.

Sta No	No beets analyzed	Av. wt. grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
140	5	684	13.00	13.68	1.06	5.00	17.80	76.85
153	5	524	7.60	7.90	2.07	4.11	12.20	64.75
350	4	642	13.65	14.50	1.52	5.86	22.00	65.90
351	6	470	11.80	12.43	1.59	5.84	18.80	66.09
352	6	392	14.30	15.22	1.62	6.06	21.20	71.79
353	5	610	14.40	15.34	1.69	6.15	21.60	71.02
354	5	590	10.80	11.47	2.00	5.81	17.80	64.42
355	5	620	13.50	14.18	1.53	4.79	18.80	75.42
356	5	760	12.35	13.02	1.90	5.12	18.70	69.60
357	8	244	18.90	20.18	1.38	6.32	22.20	90.88
358	4	730	13.60	14.43	1.88	5.77	22.00	65.60
360	6	621	10.90	11.35	1.58	3.95	16.30	69.62
364	6	475	15.65	16.55	1.88	5..42	21.20	78.05

CODINGTON COUNTY.

Ten samples of seed were distributed in this county and two samples of beets were forwarded for analysis.

Sta. No. 166, variety Desprez, came from John S. Offley, of Henry township. Stable manure was applied and a very poor stand of crop was reported. The beets were too far apart in the rows, but they had good cultivation. They were plowed twice with the shovel plow and hoed twice. He also states that they were dragged twice with open corn drag. This latter is a questionable proceedure, unless the drag be so arranged that it will not injure the tender plants. Seed was sown May 16; beets harvested Oct. 16; rows 42 inches apart and beets 6 inches in row. Yield 100 bushels per acre. Soil a black loam.

Sta. No. 361, variety unknown, was grown by Oscar P. Kemp of Watertown. The seed was planted May 10 and the beets were harvested Nov. 14. The rows were 18 inches apart and the beets 12 inches in the row. The stand of crop was fair and the yield twelve and one half tons per acre. No fertilizers were used and the beets were carefully worked with hand cultivator at least twice each week. They were thinned by hand. The poor results shown by the analysis may be due to the fact that the beets were not thick enough on the ground.

The following table shows the analysis.

Sta. No.	No beets analyzed	Av wt grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degrees Brix	Purity coefficient
166	6	849	10.00	10.35	1.39	3.35	12.60	82.06
361	4	750	7.80	8.13	2.05	4.01	13.40	60.63

DEUEL COUNTY.

Sixteen samples of seed were sent to this county and but one sample of beets was sent in for analysis. Sta. No. 299 was grown by C. H. Lester, Havana township. The beets were planted June 1, and harvested Oct. 29. The rows were 30 inches and beets in row 5 inches. Stand of crop was good and yield per acre seven and one half tons. No fertilizer was used and the soil was prairie loam and had been cropped twelve years; four years ago it was heavily manured with stable manure after which oats and wheat had been raised. The beets were cultivated and hoed. He writes: "Many of the beets were quite small, while many weighed from three to four pounds. The average weight of 100 average beets was 1.2 lbs. Ground plowed but 6 inches deep in 1890. Many beets grew with divided root, upper part of root quite thick but short. From manner of growth it appears that ground was not plowed deep enough to give room for the roots."

This sample, variety Desprez, averaged 507 grams and gave sugar in beet 11.70; sugar in juice 12.25; ash in juice 1.06; marc 4.48; degree brix 14.80; purity coefficient 82.77.

HAMLIN COUNTY.

Eleven samples of seed were sent to this county and all were distributed in the vicinity of Castlewood. Three of these samples have been heard from. S. D. Haight and T. Melor report that the plants were all destroyed by cut worms. P. E. Higgins lost nearly all by cut worms but managed to save a few by transplanting and these he sent on for analysis. This sample is unique on that account. Sta. No. 280, variety Desprez, is the sample and gave the following results: Av. wt. 513 grams; sugar in beet 9.90; sugar in juice 10.53; ash in juice 1.07, marc 5.96; degree Brix 15.70; purity coefficient 67.07.

BROOKINGS COUNTY.

Eighteen samples of seed were distributed in this county besides those grown at the Station. From the eighteen, three samples of beets were sent in for analysis.

Sta. No. 143 was grown by Z. R. Post of Alton township. No manure was applied this season but the land was previously treated with stable manure. The stand was medium and the beets were cultivated with a horse cultivator.

Sta. No. 211 came from P. D. Davis, Sherman township. Horse manure was used and the stand was good. The beets were once cultivated with a shovel plow and three times hoed.

Sta. Nos. 260, 262, 267 and 268 were grown on the college farm. No fertilizer was used and the stand of crop was 100 per cent. The beets were grown on deep rich bottom land which was plowed ten inches deep and then subsoiled six inches deeper. The beets were cultivated twice with cultivator and were hoed twice. This soil does not seem well adapted to beet culture when compared with the fine results obtained on the farm last year at which time much higher ground was selected. Some seed was sown on higher ground this year, but for some unknown cause no results were obtained.

Sta. No. 359 was raised by D R. Sweezy, Bangor township. Barn yard manure was used and a fair stand of crop secured. The ground was plowed deep and the beets were cultivated with a horse cultivator. Crop was light; cut worms destroyed most of the plants so no yield could be given.

Perhaps it might be said that all the samples from Brookings county were raised on too rich ground. Had higher ground without manure been used better results would have ensued.

The following tables complete reports:

Station No.	Variety	Planted	Harvested	Rows—inches	Beets in Row—inches	Tons per acre	Soil
143	Desprez	May 19	Oct 10	40	11	8	Black loam
211	Desprez	May 11	Oct 17	24	8	8.5	Sandy loam
260	Klein Wanzlebener	May 15	Oct 27	28	9	10.70	Black bottom
262	Vilmorin's Improved	May 15	Oct 27	28	9	10.8	Black bottom
267	Desprez	May 15	Oct 27	28	9	14.4	Black bottom
268	German	May 15	Oct 27	28	9	11.7	Black bottom
359	Desprez	May 29	Nov 3	26	....	......	Black loam

ANALYSES:

Sta. No	No beets analyzed	Av. wt grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
143	6	1294	8.00	8.26	1.50	3.18	13.60	62.20
211	8	315	10.15	10.63	1.25	4.56	14.80	71.82
260	4	648	10.80	11.30	1.01	4.43	15.40	73.37
262	4	589	13.60	14.32	62	5.07	17.60	81.31
267	4	617	10.20	10.60	92	4.03	14.30	74.34
268	4	708	11.30	11.78	94	4.06	14.10	83.55
359	5	639	11.25	11.78	1.83	4.46	17.60	66.90

LAKE COUNTY.

Three samples of seed were distributed in this county but nothing has been heard from any of them.

MOODY COUNTY.

No samples of seed were sent out from the Station to this county but three samples of beets from seed obtained elsewhere, were sent in for analysis.

Sta. No. 168 was raised by James Ashley, River View township. No fertilizers were used and the stand of crop was good. The beets were cultivated with hoe and corn plow.

Sta. Nos. 254 and 255 were grown by James Wilson of Grovena township. The ground was plowed a few days before planting, about eight inches deep. The land has been in cultivation for twelve years. The beets were tended by hoe and the weeds in row pulled by hand. The stand of crop was good.

The following tables give the remainder of report:

Station No.	Variety	Planted	Harvested	Rows—inches	Beets in row. inches	Tons per acre	Soil
168	Desprez	May 6	Oct 15	36	8	32.0	Sandy clay
254	Vilmorin	June 2	Oct 20	24	8	20.7	Sandy loam.
255	Klein Wanzlebener	do	do	24	8	18.7	do

ANALYSES:

Sta. No	No. beets analyzed	Av. wt. grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
168	6	961	11.40	11.86	1.26	3.89	15.20	78.02
254	2	571	12.80	13.61	1.08	5.92	17.00	80.00
255	2	598	10.90	11.59	1.29	5.97	16.50	70.24

MINNEHAHA COUNTY.

Eight samples of seed were sent to this county and five samples of beets were returned.

Sta. No. 167 was grown by Wm. Connolly of Wall Lake township. No fertilizer was used and cut worms killed some of the plants. He estimates the yield at about ten tons per acre. Beets were cultivated with hoe.

Sta. No. 122 came from John Engebretson of Palisade township. Manure was used and cut worms did some damage. The stand and yield could not be given.

Sta. No. 173 came from Chas. Olander, Split Rock township. No fertilizer and a full stand of crop are reported. The land had been in cultivation for twenty years and had been in timothy for the past three years The beets were hoed four times and weeded once by hand.

Sta. No. 266 was grown by O. Olson of Valley Springs. The ground had been manured the previous year with stable manure. It was plowed ten inchos deep just before the planting which was done by hand. The beets were cultivated with corn plow and with hoe.

Sta. No. 363 was grown by E. J. South of Sioux Falls township. No fertilizer was used and a poor stand of crop was reported. The land is low black loam but not wet. It had been in garden several years but last year it was in corn. The beets were hoed twice and twice cultivated with horse corn cultivator.

The following tables complete the report:

Station No.	Variety	Planted	Harvested	Rows—inches	Beets in row—inches	Tons per acre	Soil
122	Klein Wanzlebener..........	May 11	Oct 1	30	7	......	Black loam.
167	Desprez	June 20	Oct 14	18	8	10.0	do
173	...do........................	May 13	Oct 13	36	8	30.5	Black alluvial.
266	Vilmorin	May 12	Oct 14	36	....	10.0	Sandy lorm.
363	Desprez	May 30	Oct 20	46	....	......	Low black loam.

ANALYSES:

Sta. No.	No beets analyzed	Av. wt. grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
122	6	466	12.10	12.57	1.03	4.64	17.20	73.08
167	5	674	12.20	12.67	1.40	4.62	17.30	73.23
173	6	969	9.50	9.90	1.19	4.04	14.80	68.24
266	4	962	10 90	11.41	1.39	4.44	16.00	71.31
363	6	714	11.30	11..89	1.64	4.98	16.80	70.79

MCCOOK COUNTY.

Nine packages of seed were distributed in this county and four samples of beets have been returned.

Sta. No. 204 was grown by Oliver Gibbs, Jr., of Ramsey. Well rotted manure was used and beets were hoed and kept clean. The cut worms destroyed so many of the plants that the stand was thin and uneven.

Sta. No. 264 came from L. W. Robbins, Benton township. No fertilizer was used. The ground had been prepared for corn and the seed were sown quite thick in marks made by a corn cultivator. The seed was covered by dragging lengthwise of the row, and although a fine rain fell that night not one seed in fifty germinated. Beets were cultivated and hoed.

Sta. No. 297 and 298 were sent by W T. Pierce, Pearl township. No fertilizer was used and the stand was poor. The ground was plowed the preceding fall and again in May to a depth of 7 inches. Beets were hoed and weeded. Sta. No. 298 proved to be some variety of mangel.

The following tables complete the reports:

Station No.	Variety	Planted	Harvested.	Rows — inches	Beets in row — inches.	Tons per acre.	Soil
204	Desprez	May 15	Oct 16	24	....	......	Sandy loam.
264	Vilmorin	June 1	Oct 22	36	....	......	Gravelly loam.
297	Klein Wanzlebener	May 15	Oct 15	20	36	6.3	Black loam.
298	Mangelwurtzel	do	do	20	36	7-5	do

ANALYSES:

Sta. No.	No. beets analyzed	Av. wt grams	Sugar in beet	Sugar in juice	Ash in juice.	Marc	Degree Brix	Purity coefficient
204	4	1183	10.00	10.43	1.32	4.10	14.60	71.74
264	6	797	12.10	12.69	1.11	4.68	16.20	78.83
297	6	669	9.20	9.46	.69	3.77	13.00	72.77
298	4	1271	4.75	4.91	1.26	3.28	10.20	48.14

TURNER COUNTY.

One package of seed was sent to this county, but two samples of beets were sent in.

Sta. No. 341 came from John M. Downer, township 97, R. 55. Only about one hundred seeds germinated. These plants were hoed and carefully tended Seed sown May 22; beets harvested Oct. 19. The average weight of the six beets analyzed was 644 grams; sugar in beet 11.50; sugar in juice 12.16; ash in juice 1.78; degree Brix 18.60; purity coefficient 65.37.

Sta. No. 236 was raised by Dr. S. B. Tenney, Marion township. No fertilizer was used this year but last year the land was lightly manured. The seed, Desprez, were sown May 25, and beets were harvested October 19. The soil was sandy loam. The ground was plowed and the seed dropped by hand and covered one and one half inches deep. The rows were 20 inches apart and the beets stood 8 inches in the row. Hoed with a garden hoe. The season was dry and the beets were a long time coming up. The average weight was 395 grams; sugar in beet 13.40; sugar in juice 14.01; ash in juice 1.03; marc 4.36; degree Brix 16.80; purity coefficient 83.40.

LINCOLN COUNTY.

Two samples were sent to this county but neither of them have been heard from.

In general there has been but little interest in the whole region and better cultivation, deeper plowing, better selection of soil of which there is a great variety to choose from, and narrower rows with beets standing thickly in the row would bring much better results. Of course the reader will be able to find the exceptional cases in which these remarks are not applicable.

THE JAMES RIVER VALLEY REGION.

BROWN COUNTY.

Sixty-six samples of seeds were distributed in this county by the Station. In addition to these about two hundred samples were distributed by others interested. Especial interest has been taken in this work by S. W. Narregang, Secretary of the Beet Sugar Factory Committee of Aberdeen. Of the forty-six samples received for analysis, Mr. Narregang sent twenty-six. These samples are found in the first twenty six samples described.

Sta. Nos. 145, 326, 152. 327, 159 and 328 were grown by John A. Lovelace, Carlisle township. These six samples represent three varieties, one sample of each was harvested Oct. 12, and from the results obtained it was thought that the beets were yet immature. Accordingly a second sample of each was harvested Nov. 3 and sent in for analysis. The first two numbers are for the two samples of the Desprez variety. The second two are for the Klein Wanzlebener and the last two are for the Vilmorin varieties. No fertilizer was used and a full stand was obtained. The beets were hoed June 20 and 29; hoed and ridged July 10 and hoed July 20. The ground was stirred to a depth of two inches at each hoeing. June was fine growing weather and likewise most of July with some hard rains.

August 7th, hail cut the tops all to pieces; tops all died, but new ones started and grew finely thereafter.

Sta. Nos. 189, 307 and 372 were grown by Samuel Fulker, who harvested all his beets before they were ripe. The last sample was buried in the ground until Nov. 5, in order to see if more sugar would be elaborated. The ground has been in wheat for seven years, the last use being for a garden. The beets were hoed June 25, thinned July 1 and hoed July 5. June, fair rains; July, dry and cool; August and September the same; weather unfavorable for beets. Had these samples been allowed to mature they should have shown excellent results.

Sta. Nos. 219 and 371 were raised by Casper Kronschnable, 12-127-63; the first having been harvested early and the last a couple of weeks later. The land had been in cultivation eight years, mostly in potatoes and flax. Last crop flax. Beets hoed once and cultivated twice. No extra pains taken. Land plowed only seven inches deep. Weather in May wet, in June dry, August hot and dry, September at first dry, latter part rains.

Sta. No. 179 was raised by N. Rein, 33-124-63. Land had been cultivated eight years in garden and corn; last crop wheat. Plowed in April, 8 inches deep and thoroughly pulverized and dragged. Seed sown with garden drill 2 inches deep. Beets cultivated every two weeks; thinned June 1. May dry; June fair, rains; July dry and cool; August and September dry and cool and season generally unfavorable.

Sta. No. 184 was grown by M. J. Sackreiter, S. W. 29-129-62. Ground manured in 1890; plowed 10 inches deep; pulverized and seed were sown by horse drill; hoed twice and thinned. May dry; June fair, rains; remainder of season dry and all the season cool and unfavorable.

Sta. No. 188 was grown by George Vetter, 10-124-65. No fertilizer. Land plowed eight inches deep; disc harrowed just before planting; seed sown by hand; hoed twice and cultivated twice. May very dry; June, one pretty fair rain; July, one good rain. The season here was very dry, wheat yielding but 2.5 to 4 bushel per acre. The beets had but one good rain after they were up.

Sta. No. 110 was grown by J. F. Kinna, S. E. 33-125-64. Land cultivated ten years, mostly in garden; last four years in cabbage. No fertilizers used. Plowed in spring twelve inches deep. Seed sown by hand. Beets hoed twice and cultivated once.

Sta. No. 217 was raised by C. C. Matteson, Westport. The beets were hoed twice and cultivated once. Weather was at first wet and then dry. Tops of beets destroyed by hail July 12.

Sta. No. 272 was raised by J. E. Hickenbotham, 5-122-63. Land in cultivation eight years mostly in garden; last crop potatoes; plowed 9 inches deep; seed planted with garden drill; cultivated six times with drag; hoed twice; thinned and cultivated once with cultivator. May dry; June fair, rains; remainder of season dry; unfavorable.

Sta. No. 273 was grown by A. J. Ford, 6-126-64. Land in cultivation seven years; mostly wheat; plowed 7 inches deep and seed sown by hand; beets cultivated twice, hoed once and thinned. No fertilizer used. May dry; June fair, rain; July, August and September dry and cool; October, rain and cool. Season unfavorable.

Sta. No. 311 was grown by H. C. Coburn, 17-127.61. Land cultivated six years; last crop potatoes. Ground plowed 9 inches deep, and seed planted by hand one half inch deep. Hoed three times. No fertilizer ever used on land. Fair rains in June; remainder of season dry and cool; unfavorable.

Sta. No. 312 was grown by R. Christian, 1-122-64. Land in cultivation nine years. Last crop corn. Ground plowed 6 inches deep. Seed planted with garden seeder one and one half inches deep. Beets harrowed once, cultivated twice and thinned twice, June and September fair rains; remainder of season dry and cool. Unfavorable. No fertilizer used.

Sta. No. 325 was grown by Willie Fritsche, 34-123-63. Land in cultivation ten years, mostly in potatoes; last crop barley. Ground plowed 10 inches deep and seed sowed by hand two inches deep. Beets hoed three times. No fertilizer. June and September fair rains and remainder of season dry; hot in August.

Sta. No. 343 was grown by A. McLane, 12-124-67. Ground plowed 8 inches deep and seed sown by hand one inch deep. Beets cultivated twice and thinned to 10 inches in the row. Weather same as last sample.

Sta. No. 344 was grown by Daniel Kight, 6-124-64. Land in cultivation six years. Plowed in fall 6 inches deep and cultivated before seeding. Seed planted by hand one inch deep. Beets hoed three times and thinned. Weather same as last.

Sta. Nos. 149 and 308 were grown by C. T. Richmond, 26-121-64. He sent the first sample to the Station direct and Mr. Narregang sent in the second sample later. Land in cultivation nine years, mostly in carrot and beets. Plowed nine inches deep and seed sown by hand 2 inches deep. Beets hoed four times. Fair rains in June; remainder of season dry and unfavorable. No fertilizer used.

Sta. Nos. 324, and 335 to 339 were grown by C. J. Edson. 2-123-64. All but the first two numbers were sent direct by Mr. Edson; the first two were sent by Narregang. Land was plowed the preceding October and again in May. Beets were hoed three times and thinned. Fair rains June and September; the rest of the season was dry.

In general concerning the work in Brown county Mr. Narregang writes: "I am sorry some of the beets show such a low rate of sugar; but the tonnage is excellent. Owing to the fact that our farmers got their beets planted so far apart and the soil is so productive, they have grown too large and bulky. And again the samples they bring in I find are among the very largest beets which they have. We are well satisfied with the growth of the sugar beet and believe that just as soon as our people understand what to do and how to do it we will have no trouble in raising all the beets we want for a factory."

Sta. Nos. 119 and 135 were grown by L. Freeman, Bath township. No fertilizer was used. The beets were planted between rows of potatoes and were cultivated and hoed twice The samples were taken before they were ripe.

Sta. No. 124 was grown by J. K. Russel, Westport, who says the beets were raised according to instructions. This sample was immature.

Sta. No. 155 was grown by E. Churchill, Henry township. No fertilizer was used and the stand was very good. The beets were cultivated by hand hoe. Owing to the drouth in this immediate vicinity crops were almost a total failure. Corn and cabbage in the same plot with the beets were not worth gathering.

Sta. No. 158 was grown by W. F. Crockard, Claremont township. No fertilizer was used and the stand of crop was fair. Beets were cultivated with hoe.

Sta. No. 177 was grown by Jas. Leak, Claremont. No fertilizer was used and stand was poor. Beets were cultivated with cultivator and hoe. The season was unfavorable. The beets were injured badly by wind when small; also by hail July 20 and Aug. 4th, the leaves all being destroyed.

Sta. No. 192 was grown by Joseph Stearns, Claremont township. No fertilizer was used and the stand was poor. Ground was plowed 12 inches deep and beets were cultivated once and hoed once.

Sta. No. 215 was grown by John Wade, Claremont. In 1889 land was manured with a light covering of hen manure and was planted to corn last year. Stand of crop was medium. Beets were cultivated with hoe and kept perfectly clean from weeds.

Sta. No. 233 was grown by W. F. Hohensee, of Brainard township. No fertilizer and very good stand of crop. Beets cultivated with hoe.

Sta. No. 237 was grown by Nelson Washburn of Westport. Land used for garden for six years. Plowed eight inches deep. Seed sown with garden drill and beets cultivated with the same machine, using different fixtures. No fertilizer used. Weather very dry until May 30, then wet and good growing weather until August when it was hot and dry till the middle of September, when it rained after which the weather continued favorable. This sample should have been left in the ground at least two weeks longer.

Sta. No. 241 was grown by M. L. Inscho, Carlisle township. The beets were planted according to directions but the cut worms destroyed all but about two hundred of the young plants. These grew finely. The beets were plowed twice and hoed twice and weeded by hand.

Sta. Nos. 277 and 309 were raised by Mrs. H. B. Miller, Detroit township No fertilizer was used and a good stand was obtained. Beets were cultivated with cultivator and hoe. The first sample was such a poor one, that Mrs. Miller was requested to send a second, harvested later.

Sta. No. 291 was sent by W. O. Chase, Osceola township. No fertilizer and good stand of crop. The soil was prairie loam with a mixture of gray soil which is found in flat lands in this section. Beets cultivated with hoe and horse cultivator.

Sta. No. 294 was grown by C. O. Case, Bath township. No fertilizer and medium stand. Land in cultivation seven years, chiefly in garden vegetables; plowed 6 inches deep and beets hoed and cultivated when necessary. The reason of poor stand was cut worms and dry weather.

Sta. No. 300 was grown by C. R. Kimball, Ordway township. No fertilizer and good stand of crop. Soil was rather poor owing to poor cultivation previously. Land plowed 6 inches deep and beets hoed and cultivatəd and thinned.

Sta. No. 301 came from W. W. DeLa, Shelby township. The beets were planted in a basin and the heavy rains just after they came up drowned a large portion of the young plants.

Sta. No. 306 was raised by Charles L. Smith, Detroit township. Land used six years for a garden. Plowed 10 inches deep and beets hoed four times. Weather was dry till middle of May and plentiful rains fell in June. Fine growing weather in July and August was hot and dry. Heavy rains in September.

Sta. No. 320 came from E. T. Scott of Frederick. Land rather poor; in cultivation nine years. Beets plowed once with double shovel plow and hoed once. Cut worms spoiled the experiment.

W. T. Wing of Bath, Edward Johnson, of Frederick, W. H, Albright of Detroit and W. A. Harris of Frederick report that cut worms prevented them from carrying out the work properly.

The following tables complete the reports:

Station No.	Variety	Planted	Harvested	Rows—inches	Beets in row—inches.	Tons per acre	Soil
145	Desprez	May 20	Oct 12	22	8	16.8	Black sandy loam.
326	...do	do	Nov 3	22	8	16.8	do
152	Klein Wanzlebener	May 15	Oct 12	22	....	20.6	do
327	........do	do	Nov 3	22	....	20.6	do
159	Vilmorins Improved	do	Oct 12	22	....	9.8	do
328	......do	do	Nov 3	22	....	9.8	do
189	Vilmorin	June 15	Oct 9	18	....	21.2	do
307	....do	do	do	18	8	21.2	do
372	...do	do	do	18	...	21.2	do
219	....do	May 15	Oct 16	30	....	......	Sandy loam.
391	....do	do	Nov 1	30	....	......	do
179	...do	April 29	Oct 14	18	....	6.8	Black sandy loam.
184	...do	May 25	Oct 16	18	...	28.1	do
188	Klein Wanzlebener	May 11	Oct 16	24	....	6.8	do
190	Vilmorin	May 12	Oct 16	18	....	57.5	do
217	....do	May 20	Oct 21	20	....	13.5	do
272	....do	May 8	Oct 24	18	....	17.0	do
273	....do	May 20	Oct 20	24	....	21.8	do
311	Klein Wanzlebener	May 8	Oct 15	24	....	17.6	do
312	Vilmorin	May 15	Oct 31	18	....	32.7	do
325	Klein Wanzlebener	May 8	Oct 19	18	....	65.3	Black loam.
343	Vilmorin	May 20	Oct 12	36	....	49.5	do
344	Klein Wanzlebener	May 2	Oct 23	15	....	26.2	do
149	Desprez	May 15	Oct 16	24	8	32.5	do
308	....do	do	Oct 18	24	8	2.5	do
329	Vilmorin	May 12	Nov 4	18	....	26.1	do
338	....do	do	do	18	....	26.1	do
324	Klein Wanzlebener	do	do	18	....	14.4	do
335	........do	do	do	18	....	14.4	do
336	Seed from Philadelphia Sugar Refinery	do	do	18	....	26.5	do
337	White French	do	do	18	....	18.4	do
339	French Red Top	do	do	18	....	30.5	do
119	Desprez	May 14	Sept 26	36	6	4.4	do
135	....do	do	do	36	6	4.4	do
124	....do	May 10	Oct 12	24	6	......	....
155	....do	May 20	Oct 13	32	8	24.5	Upland loam
158	...do	May 12	Oct 13	27	8	28.9	Black, light loam.
177	....do	May 15	Oct 14	30	8	20.0	Black sandy loam.
192	...do	May 22	Oct 14	48	8–48	2.7	Sandy loam.
215	....do	May 16	Oct 18	24	16	20.0	Black loam.
233	....do	May 20	Oct 17	18	6	63.9	do
237	Klein Wanzlebener	May 11	Oct 17	20	....	11.6	do
241	Desprez	May 19	Oct 13	24	....	......	Gravelly loam.
277	....do	May 30	Oct 20	18	4	......	Black loam.
309	....do	do	Nov. 4	18	4	......	do
291	...do	May 15	Oct 10	20	8	17.0	Light loam
294	....do	May 13	Oct 26	24	10	22.0	Black loam.
300	....do	May 15	Oct 21	24	5	25.0	do
301	....do	May 11	Oct 22	36	....	......	do
306	....do	May 15	Oct 28	16	....	.....	do
320	....do	May 28	Oct 20	....	....	......	do

ANALYSES.

Sta. No	No beets analyzed	Av. wt grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
145	3	562	12.80	13.52	1.56	4.57	18.20	74.06
326	2	392	14.80	15.72	.81	5.85	19.10	80.61
152	3	744	13.20	13.89	1.33	4.25	17.80	78.03
327	3	414	12.00	12.6[illegible]	1.24	5.19	17.50	72.28
159	3	389	14.60	15.34	.96	5.51	18.80	81.60
328	2	535	16.20	17.05	.89	6.10	20.10	80.12
189	4	623	7.30	7.58	1.44	3.65	12.70	59.68
307	4	275	9.00	9.68	1.18	6.97	16.00	60.05
372	9	221	10.10	10.63	1.34	5.00	15.50	68.59
219	3	1484	11.40	11.92	1.49	4.39	16.20	73.58
391	5	391	15.45	16.20	1.33	5.27	20.00	81.02
179	4	771	10.10	10.61	1.58	4.82	16.60	63.92
184	3	1181	10.[illegible]0	10.67	1.32	4.44	15.20	70.20
188	5	636	8.80	9.18	1.12	4.15	14.60	62.88
190	6	517	10.90	11.43	1 20	4.62	15.70	72.80
217	2	673	10.30	10.80	1.34	4.62	14.40	75.00
272	4	505	9.20	9.61	1.02	4.34	13.50	71.18
27[illegible]	6	581	11.50	12.08	1.49	4.82	16.30	73.50
311	3	1058	12.50	13.06	1.22	4.35	17.50	74.62
312	6	331	12.50	13.16	1.13	5.01	16.70	78.80
325	4	344	14.70	15.53	1.32	5.34	19.40	84 00
343	9	173	15.50	16.65	1.19	6.89	21.00	79.30
344	5	234	17.50	18.66	1.03	6.23	21.20	88.01
149	6	687	12.10	12.[illegible]2	1.49	4.06	18.00	76.66
308	6	422	14.00	14.55	1.24	5.20	17.10	85.05
329	4	299	16.40	17.55	1.11	6.55	20.90	80.00
338	3	259	14.30	15.20	1.06	5.91	18.60	81.18
324	4	338	14.60	15.63	1.09	6.63	19.50	80.00
335	3	262	12.20	12.98	1.39	6.13	16.50	78.66
336	1	350	13.40	14.32	1.37	6.41	17.70	80.90
337	1	537	13.20	14.06	1.31	6.12	18.20	76.70
339	1	442	15.40	16.24	1.26	5.15	19.10	85.02
119	6	377	12.00	12.64	1.67	5.11	18.20	69.40
135	6	400	11.80	12.41	1.65	4.96	18.00	68.95
124	6	406	9.30	9.73	1.24	4.16	14.80	65.74
155	6	951	11.40	11.94	1.24	4.55	16.00	74.63
158	6	912	10.70	11.17	1.48	4.25	15.00	74.47
177	6	851	9.70	10.13	1.31	4.25	14.70	68.81
192	3	2027	7.20	7.49	1.48	3.87	13.00	57.61
215	6	587	12.30	12.93	1.57	4.86	17.80	72.64
233	6	1000	11.30	11.69	1.43	4.17	15.80	73.98
237	8	333	10.60	11.01	1.40	4.52	16.20	67.97
241	6	615	10.30	10.82	1.44	4.78	15.40	70.26
277	1	1360	10.75	11.47	1.94	6.28	18.30	62.13
309	5	821	11.50	12.09	1.36	4.93	16.10	74.47
291	5	726	11.60	12.15	1.68	4.57	16.70	72.75
294	6	921	13.00	13.69	1.58	4.32	15.60	87.75
300	6	567	15.60	16.12	1.50	5.70	18.20	83.03
301	3	1035	8.40	8.81	1.24	4.47	13.20	66.74
306	2	564	11.40	12.28	1 67	7.18	18.30	67.11
320	3	1036	9.50	9.86	1.74	3.71	14.20	61.44

McPHERSON COUNTY.

Seven samples were distributed in this county and four packages of beets have been sent in for analysis. All these samples have an average of over 13 per cent sugar in the beet.

Sta. No. 232 was grown by Ira P. Clark of Leola. He made preparation to irrigate the beets but there was little need of water. The land had been in use for growing vegetables for about six years. The seed was sown with hand drill and cultivated with the attachments for same. A good stand was obtained.

Sta. No. 247 was grown by John Weber, Weber township. No fertilizer was used and the stand was good. This sample gives the lowest results in sugar which is probably due to the great distance apart to which the beets were thinned. A hoe was used to cultivate the beets.

Sta. No. 278 was grown by J. G. Oulson, Washington township. No fertilizer and a good stand. Land cultivated 7 years; plowed 12 inches deep. Beets hoed, cultivated, thinned and weeds kept out clean all summer. In fact the instructions had been followed faithfully and the good results obtained are sufficiently apparent.

Sta. No. 295 was grown by J. O. A. Bennett of Leola. No fertelizer was used and a very good stand was obtained. Beets were hoed three times. This was a fine sample.

A report also came from L. A. Rice, Hillsview township who also had good success, but his sample failed to reach the Station.

The following tables complete the report:

Station No.	Variety	Planted	Harvested	Rows — inches	Beets in row—inches	Tons per acre	Soil
232	Desprez	May 10	Oct 78	18	....	21.8	Sandy loam.
247	....do	May 18	Oct 15	18	18	16.9	do
278	....do	May 11	Oct 24	24	8	14.9	Prairie loam.
295	....do	May 15	Oct 19	20	10	20.4	Black prairic.

ANALYSES:

Sta. No.	No. beets analyzed.	Av. wt. grams	Sugar in beets	Sugar in juice,	Ash in juice.	Marc	Degree Brix.	Purity coefficient.
232	3	491	13.40	14.02	1.70	4.45	18.40	76.20
247	5	791	12.10	12.66	1.27	4.45	16.00	79.13
278	6	435	13.90	14.68	1.05	5.34	18.20	80.66
295	6	581	14.00	14.78	1.14	5.35	16.60	82.23

EDMUNDS COUNTY.

Thirty one samples of seed were distributed in this county and eight samples of beets were sent in for anaysis. Two farmers reported failures. A. L. Crane, Roscoe, reports his sample destroyed by stock and A. I. Wall, Vermont City, says his beets were too small to send owing to drought.

Sta. No. 178 was grown by C. W. Huntley, Huntley township. No fertelizer was used. Cut worms destroyed so many that the beets were too thin on the ground and data could not be obtained. Beets were cultivated twice and hoed twice.

Sta. No. 191 was grown by S. Bakkegard, Modena township. No fertilizer was used and the stand of crop was good. Beets were kept clean from weeds but were not hoed. He states that the seed did not germinate till after May 30 when a good rain fell. They would have done better had they been hoed.

Sta. No. 208 was grown by W. H. H. Dickinson, Vermont township. No fertilizer used and crop light owing to dry weather. Beets cultivated by hand and it was well done.

Sta. Nos. 216, 220, 222 and 230 were grown by Mr. W. K. Pratt, Glen township. Nos. 220, 230 and 216 were harvested Oct. 13:, and 222 Oct. 19 after a hard freeze. 230 was raised in a "Gumbo" patch. 220 is average size and No. 216 is large size. He writes "I have grown these beets as nearly as possible as a large field would be worked. The land has been cropped six times and has been worked to a depth of six inches. It was prepared for beets by plowing 10 inches this spring. After waiting three or four days I cultivated it up fine and then dragged down fine. Marked the ground and sowed the seed by hand. The seed was soaked before planting and it came up well. Cut worms were bad". The land is a low clay. No fertilizer used. Cultivated and hoed as needed. The four samples were analyzed just as sent.

Sta. No. 239 was grown by John Bergman, Fountain township. No fertilizer used and the beets were cultivated with hoe.

Sta. No. 257 was grown by R. Barrows, Rosette township. Manure from cow stable and hen house was used and stand was very good. The land was high ground, plowed 7 inches deep at planting time. Was manured last year and last crop was sugar beets.

Sta. No. 274 was grown by Lester Crane, Sangamon township. A little barn yard manure was used. The land has been in cultivation three years and beets were cultivated and hoed.

Sta. No. 319 was raised by G. H. Osborn, Fountain township. No fertilizer and very poor stand of crop. Beets were hoed once and cultivated twice.

The subjoined tables complete the reports:

Station No.	Variety	Planted	Harvested.	Rows — inches	Beets in row — inches.	Tons per acre.	Soil
178	Desprez	May 12	Oct 15	40	10	......	Sandy loam.
191	....do	May 16	Oct 16	16	6	32.7	Black loam.
208	....do	May 20	Oct 16	20	6	13.0	Dark loam.
216	....do	May 22	Oct 13	28	7	9.0	Low clay.
220	....do	do	do	28	7	9.0	do
222	....do	do	Oct 19	28	7	9.0	do
230	....do	do	Oct 13	28	7	9.0	"Gumbo."
239	Vilmorin	May 18	Oct 18	30	18	9.0	Black loam.
257	Desprez	May 12	Oct 15	46	8	10.0	do
274	....do	May 15	Oct 21	24	6	21.0	do
319	....do	May 11	Oct 12	30	....	3.0	....

ANALYSES:

Sta. No.	No. beets analyzed	Av. wt. grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
178	6	862	8.50	8.80	1.26	3.81	13.70	64.45
191	6	1014	8.05	8.34	1.35	3.69	13.60	61.32
208	6	1143	11.30	11.84	1.25	4.54	16.40	72.20
216	6	678	10.00	10.42	1.11	4.08	14.40	72.36
220	4	694	10.50	10.99	1.39	4.44	16.50	66.61
222	4	995	9,40	9.87	1.46	4.18	14.40	68.13
230	4	697	9.30	9.72	1.37	4.33	15.00	64.80
239	6	676	12.60	13.26	1.36	5.01	17.60	75.34
257	3	656	10.80	11.40	1.96	5.23	17.20	66.28
274	6	506	11.20	11.81	1.42	5.17	15.70	75.86
319	3	899	12.80	13.49	1.64	5.09	16.70	80.78

FAULK COUNTY.

Fourteen samples of seed were sent to this county and eight samples of beets were sent in for analysis.

Sta. No. 133 was grown by E. J. Tuttle of Burkmere. No fertilizer was used and the beets were hoed and cultivated.

Sta. No. 146 was grown by A. C. Voss, 119, R. 70. The beets were raised on old land, flax stubble. The stand was good but the yield could be increased by better cultivation. The beets were hoed.

Sta. No. 169 was raised by L. L. Turpin, Union township. No fertilizer was used and the beets cultivated with a cultivator and hoe.

Sta. Nos. 201 and 202 were raised by Dr. S. S. Wentworth, township 120. No fertilizer was used and the stand of crop was fair The beets were cultivated with hand cultivator and kept entirely free from weeds. The second sample is a rose colored variety, seed not imported.

Sta No. 231 was raised by W. S. Thorn, Oakland township. No fertilizer was used and stand of crop was fair. Beets cultivated with two horse cultivotor once a week up to harvest. Ground plowed very deep.

Sta. No 292 was raised by Charles Hunter of Seneca. The seed was sown by hand and no fertilizer was used.

Sta. No. 313 was grown by Edwin Wright, Seneca township. Land in cultivation five years. Land is sloping and was manured previous year, stand fair. Land plowed eight inches deep, seed planted by hand one inch deep. Beets hoed twice and cultivated twice.

The following tables complete the reports:

Station No.	Variety	Planted	Harvested	Rows — inches	Beets in row—inches	Tons per acre	Soil
133	Desprez	May 20	Oct 10	48	5	9	Black loam.
146	....do	May 8	Oct 13	24	8	11	....
169	....do	June 1	Oct 15	36	18	......	Black sandy.
201	....do	May 4	Oct 16	48	8	25	Bl'k loam with sand.
202	Champion	do	do	48	8	30	do
231	Desprez	May 11	Oct 15	42	5	5	Black rich loam.
292	French White	May 13	Oct 21	24	6	25	Sandy loam.
313	Desprez.	May 15	Oct 15	24	....	16	....

ANALYSES:

Sta. No.	No. beets analyzed.	Av. wt. grams	Sugar in beets	Sugar in juice,	Ash in juice.	Marc	Degree Brix.	Purity coefficient.
133	6	335	14.50	15.28	1.38	5.13	20.40	74.90
146	6	644	9.00	9.40	1.24	4.25	15.60	60.25
169	6	907	11.00	11.57	1.17	4.59	15.20	75.80
201	6	1222	8.80	9.14	1.64	3.65	13.40	68.21
202	6	1328	9.30	9.61	1.46	3.21	14.10	68.15
231	6	536	12.60	13.26	1.38	5.00	17.20	77.09
292	6	775	10.10	10.43	1.25	3.20	14.10	74.00
313	2	561	12.50	13.15	1.15	5.72	17.00	85.60

SPINK COUNTY.

Thirty five samples of seed were distributed throughout this county and twelve samples of beets have been returned.

Sta. No. 125 was grown by Michael Connor, Lake township. No fertilizer was used and stand of crop was poor owing to dry weather. Beets were cultivated and hoed as often as necessary to keep clean.

Sta. No. 161 was raised by Thomas Lambert of Ashton. No fertilizer and beets were worked with garden drill.

Sta. No. 165 was grown by C. F. Richard, Crandon township. No fertilizer was used and beets were hoed.

Sta. No. 176 was raised by Freeman Young, Athol township. No fertilizer used and half crop secured. Beets cultivated with hoe and shovel plow.

Sta. No. 206 was grown by Henry Wilson, Frankfort township. No fertilizer was used and stand fair. Last crop on land potatoes. Beets hoed. He writes "Cut worms destroyed fully half of crop and seriously retarded growth of rest; and just previous to digging the beets, found that the moles were eating them."

Sta. No. 244 was grown by W. F. Bruell of Redfield. Beets were cultivated and hoed. "Dry weather caused the beets to grow small, the specimens sent being the best (probably he means the largest); the remainder are much smaller." Had the directions for sampling been observed the analysis would have shown better results.

Sta. No. 249 was grown by Messrs. John and C. B. Ward of Ashton. The beets did not start till after May 30. Season dry. No fertilizer, medium stand. Beets plowed and hoed.

Sta. No. 296 was raised by R. Bingham, Lodi township. No fertilizer was used and one fourth stand was obtained. "The beets did not do very well owing to cut worms and dry weather; they are quite small. In some rows there were no beets for three rods and then again they are all right." The analysis shows that small beets are best for the sugar maker.

Sta. Nos. 345 and 346 were sent by Julius Liebig of Frankfort. They were fine samples. No fertilizers were used. Potato ground, no rain from June on. Beets cultivated by hoe.

Sta. No. 370 was grown by Robert C. Kimmel, Beotia township. Beets were cultivated four times and a good stand was secured.

Sta. No. 373 was grown by Geo. W. Garrett, Lake township. No fertilizer was used and a good stand. Beets cultivated with small cultivator.

The following tables complete the reports:

Station No	Variety	Planted	Harvested	Rows—inches	Beets in row—inches.	Tons per acre	Soil
125	Desprez	May 1	Oct 12	24	9	12	Dark loam.
161	....do	May 18	Oct 12	18	8	15	Black loam.
165	....do	May 14	Oct 15	18	10	11	Brown loam.
176	....do	May 15	Oct 17	48	8	4	Upland prairie
206	....do	May 20	Oct 15	24	6	2	Upland.
244	....do	May 11	Oct 10	36	6	10	Rich black.
249	....do	May 6	Oct 17	24	10	13.2	Black loam.
296	....do	May 20	Oct 20	36	....	5	do
345	German	May 18	Oct 26	18	6	16.6	Black prairie loam.
346	French	May 18	Oct 26	18	6	17	do
370	Desprez	May 15	Oct 25	24	8	7	Light black loam.
373	....do	May 10	Oct 10	36	8	5	Clay subsoil.

ANALYSES.

Sta. No.	No. beets analyzed	Av. wt. grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
125	6	853	9.70	10.06	1.65	3.60	15.20	66.25
161	6	1427	7.50	7.85	1.40	4.50	15.80	50.00
165	6	675	10.50	10.98	1.56	4.42	16.60	66.14
176	6	628	11.60	12.15	1.30	4 64	16.80	72.32
206	6	263	12.05	12.77	1.47	5.69	15.20	84.01
244	6	750	10.50	11.03	1.44	4.84	14.30	77.13
249	6	484	11.00	11.59	1.27	5.13	16.20	71.54
296	6	423	15.65	16.53	1.18	5.30	21.20	77.97
345	3	417	16.00	16.96	1.35	5.70	21.20	80.00
346	3	399	17.80	18.85	1.14	5.56	22.20	84.91
370	6	162	16.10	17.38	1.53	7.39	22.20	78.64
373	4	884	11.40	11.92	1.55	4.32	16.10	74.01

CLARK COUNTY.

Twenty four packages of the seed were distributed throughout this county and three samples of beets have been returned.

Sta. No. 185 came from A. Grover, Lake township. Land plowed in May 8 inches deep. Seed planted with a garden drill four inches deep, and they did not germinate for three weeks. Cut worms destroyed half the young plants.

Sta. No. 221 was grown by John Vercoe, Blaine township. No fertilizer was used and a very even stand of beets was obtained. Land cultivated 4 years; last crop wheat. Planted and cultivated with a garden drill, hoed twice and thinned.

Sta. No. 224 was grown by D. L. Talcott, Warren township. "The seed germinated all right but the cut worms took nearly all the young plants. We have had an unusually dry season and I did not plant the seed until June 3, on account of its being so dry. May 30 we got a good rain, the only one of the season. I only harvested two bushels but they were very nice."

Station No.	Variety	Planted	Harvested	Rows—inches.	Beets in Row—inches	Tons per acre	Soil
185	Desprez	May 20	Oct 23	42	....	5.0	Sandy ioam
221	....do	May 15	Oct 11	24	9	10.6	Rich black loam.
224	....do	June 3	Oct 17	36	....	.....	Black sandy loam.

ANALYSES:

Sta. No	No beets analyzed	Av. wt grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
185	14	193	12·00	12.63	1.31	5.00	16.80	75.18
221	6	519	14.00	14.74	1.61	5.02	16.30	90.43
224	6	578	11.00	11.49	1.58	4.24	15 80	72.09

HAND COUNTY.

Six samples of seeds were distributed in this county and three packages of beets have been returned. Beside these, two have reported failures. Mrs. D. E. Flower of Clyde lost the crop through the interference of the drab potato bug and dry weather. C. C. Campbell of Dean lost his plants by cut worms.

Sta. No. 120 was grown by Micheal Lemmon, Greenleaf township. He reports the crop poor owing to dry weather, cut worms, and hail on the 15th of July which killed all the tops. No fertilizer was used and beets were plowed five times and hoed.

Sta. No. 131 was grown by Oliver Pash, St. Lawrence township. No fertilizer. Land was new, simply broke and then backset deeper. Land close to creek bottom. Harrowed and planked till quite smooth before planting. Beets hoed twice and thinned.

This is the first sample reported from raw prairie land and the analysis shows it to be a fine sample. It would have been better had the sample stood three or four weeks longer before harvesting.

Sta. No. 154 was grown by A. C. Justice, Burdette township. No fertilizer was used. The cut worms spoiled the crop in spite of the fact that the worms were twice hand picked. Only a dozen plants survived.

The following tables complete the reports:

Station No.	Variety	Planted	Harvested	Rows—inches	Beets in row. inches	Tons, per acre	Soil
120	Desprez.	May 10	Oct 10	46	6	......	Rich upland
131	....do	May 29	Sep 22	18	6	7.5	Rich sandy loam.
154	....do	May 19	Oct 15	30	....	......	Li't clay & sandy l'm

ANALYSIS:

Sta. No.	No. beets analyzed.	Av. wt. grams.	Sugar in beets.	Sugar in juice.	Ash in juice.	Marc.	Degree Brix.	Purity coefficient.
120	6	428	10.80	11.23	1.52	3.83	15.80	71.00
131	6	266	17.80	18.88	1.29	5.74	22.40	84.73
154	6	540	8.20	8.57	1.39	3.77	12.00	71.42

BEADLE COUNTY.

Fifty four samples of seed were distributed in this county and twenty eight samples have been analyzed.

Sta. Nos. 199 and 261 were grown by A. W. Wilmarth, township 110-62. The land is upland and was plowed 8 inches deep, harrowed and rolled. The seed was sown by hand drill. Beets were cultivated once, hoed once and thinned. No fertilizer was used and stand of crop was good. First sample was large beets and second sample average size.

Sta. No. 198 was also grown by Mr. Wilmarth but upon low river bottom land and the ground was plowed 12 inches deep. Same cultivation as preceding samples. Stand good and no fertilizer.

The four following samples were collected by Mr. Wilmarth and sent in for analysis.

Sta. No. 314 was grown by C. W. Barringer, township 110-62. This sample was irrigated with artesian water and the stand was good. Land was plowed 12 inches deep. Beets were hoed, thinned and weeded.

Sta No. 315 was grown by J. A. Colcord, township 110-62. No fertilizer was used and the stand was good. Land plowed in April 12 inches deep. Beets were hoed, thinned and weeded.

Sta. No. 316 was grown by A. B. Melville township 110-61. Data same as in previous sample.

Sta. No. 270 was grown by C. W. Witmar of Broadland. No data could be obtained.

Sta. Nos. 365, 366, 367, and 369 were grown by N. T. Smith, Huron township. No fertilizer was used. The first and last grown on river bottom land and the stand was good. The other two were grown on upland and the stand was fair. The beets were cultivated and hoed.

Sta. No. 126 came from F. Campbell Clyde township. Good stand and no fertilizer. Beets plowed and hoed.

Sta. No. 121 was grown by C. A. Blake, Whiteside township. No fertilizer was used and good stand.

Sta. No. 129 was grown by B. E. McIlvaine, Clyde township. A mixture of stable and hen manure was used and the beets were cultivated with a corn cultivator.

Sta. No. 130 was raised by P. A. Bullock, Sand Creek township. No fertilizer was used and stand was fair. Land plowed deep last fall and again just before planting. Hoed crops have been on ground for last two years. Beets received about the same cultivation as corn. Cultivated three times and hoed twice. Two large beets weighing seven or eight pounds each were sent beside the sample.

Sta. No. 143 was raised by Mrs. A. A. Frank, Hartland township. No fertilizer and three fourths stand of crop was reported. Beets cultivated and hoed.

Sta. No. 160 was grown by M. Gray, Clyde township. Good stand and no fertilizer are reported. Beets are cultivated with hoe and cultivator.

Sta. No. 203 was raised by E. W. Crouch, Iowa township. No fertilizer and one fourth stand are given. Land in cultivation seven years, chiefly in corn and potatoes. Last crop corn. The land has a gentle slope and lies about six feet above the river bottom. Plowed in May 8 inches deep, harrowed and seed planted with hand corn planter in hills two inches deep and 12 inches apart. Beets cultivated twice and hoed once. The seed came up well but a heavy rain, June 15, covered up and washed out about three-fourths of the plants leaving the hills six feet apart. Did not thin out any and took sample from crowded hill. Single plants growing alone weighed seven to eight pounds.

Sta, No. 226 was grown by J. W. Smith, Wessington township. Barn yard manure was used and cut worms spoiled the experiment. Beets were hoed.

Sta. No. 234 was raised by Charles May, Valley township. Well rotted barn yard manure was used and stand was good Cultivated three times and hoed once.

Sta. No. 248 was grown by Holden Cook, 109-63. Good stand and no fertilizer are reported. The beets were not cultivated at all, except that a few weeds around the plants were pulled out. Land had four crops on it and was clean and nice, plowed deep in the spring.

Sta. No. 263 was grown by Noyes Appleman, Cavour township. No fertilizer was used and cut worms spoiled the experiment.

Sta. No. 275 was grown by J. C. Hatfield, Iowa township. No fertilizer was used and beets were cultivated same as corn,

Sta. No. 282 comes from Edward Lynch, Banner township. Cut worms destroyed all the plants except a few straggling ones in different parts of the plat.

Sta. No. 284 was grown by J H Miller on the Hitchcock farm. No fertilizer and a good stand are reported. Beets were cultivated and hoed.

Sta. No. 318 was grown by W. R. Thurston, Clifton township. Beets were not thinned, but were hoed and weeded by hand.

Sta. No. 323 comes from Wilfred Baker. Wolsey. All conditions were favorable. But cut worms destroyed the symmetry of the stand. Weather wet during the first part and dry during the last of the season. Beets hoed three times.

Sta. No. 334 was grown by W. E. Mexon, Lake Byron township. Beets grown on river bottom with barn yard manure and stand not very good. In mangels the year before. Beets cultivated twice, hoed twice and weeded by hand. Would have been better without the manure.

W. F. Van Horn, Dearborn township reports failure from drought, and George Frank of Garfield township lost his beets by cut worms.

The following tables finish the reports:

Station No.	Variety	Planted	Harvested	Rows—inches	Beets in row—inches	Tons per acre	Soil
199	Mette	May 15	Oct 24	18	6	17.8	Upland sandy loam.
261	..do	do	do	18	6	17.8	do
198	Klein Wanzlebener	do	Oct 21	18	6	22.9	River bot'm b'k loam
314	Mette	Apr 30	Nov 1	16	6	46.5	Black sandy loam.
315	..do	May 10	Oct 30	16	6	26.0	do
316	Klein Wanzlebener	May 12	Nov 1	18	6	34.0	do
270	....	....	....	....	....	....	....
365	Klein Wanzlebener	May 20	Nov 5	18	6	56.5	Deep bl'k river bot'm
366	Mette	May 19	Oct 30	18	7	17.5	Upland prairie.
367	Klein Wanzlebener	May 15	Nov 4	16	6	32.6	do
369	Mette	May 16	Nov 2	18	6	72.9	Deep bl'k river bot'm
121	Desprez	June 6	Oct 12	16	6	14.4	Sandy loam.
126	....do	May 15	Oct 10	24	10	36.0	Black loam.
129	....do	May 14	Oct 12	44	8	....	Sandy loam.
130	....do	May 20	Oct 6	36	16	10.0	Bl'ck, very little sand
148	....do	May 17	Oct 8	44	6	6.0	Black sandy loam.
160	....do	May 18	Oct 15	20	6	8.0	Sandy loam.
203	....do	May 28	Oct 19	44	12	8.8	Clay loam.
226	....do	June 18	Oct 12	....	....	....	Black loam.
234	....do	May 15	Oct 15	24	6	15.0	do
248	....do	May 1	Oct 12	18	4	42.0	Black sandy loam.
263	....do	May 25	Oct 17	36	....	....	Black sandy loam.
275	....do	May 12	Oct 15	44	8	24.0	Sandy loam.
282	....do	May 4	Oct 28	24	8	....	....
284	Mette	May 21	Oct 26	20	8	34.3	Black loam, 2 ft. deep
318	Desprez	May 8	Nov 5	20	4	36.0	River bot'm b'k loam
323	...do	May 25	Oct 16	18	....	....	....
334	....do	May 20	Oct 25	24	11	48.5	Black loam.

ANALYSES:

Sta. No.	No beets analyzed	Av. wt. grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
199	6	567	15.30	16.02	1.42	4.48	18 80	85.21
261	6	289	18 50	19 58	.70	5.54	21.20	92 36
198	6	745	10.50	10.95	1 53	4.12	15.40	71 10
314	6	609	16.10	16 90	1.30	4.74	19.90	84.92
315	6	305	14 80	15.44	1.42	4 12	19 20	80.42
316	6	583	13.00	13.58	1.45	4.33	19.00	71 47
270	6	418	8 00	8 36	1.30	4.26	12.70	65 82
365	2	746	12.70	13.30	1 78	4 49	18.60	71.49
366	2	558	15.20	16.14	1.51	5.84	21 00	76 86
367	2	555	12.50	13.27	1 47	5.83	18.40	72 14
369	3	431	15.20	16 02	.79	5.09	20 40	78.53
121	6	654	10.20	10.78	1.35	3.56	15 00	71.86
126	6	1472	10.90	11 30	96	3.55	15.20	74 34
129	6	2020	7.30	7.52	1.57	3.11	11.10	67.74
130	6	880	8.70	9.02	1 57	3.66	13 80	65.36
143	6	1043	9.10	9.48	1.61	3.97	14.00	67 71
160	6	1008	11 20	11.76	1.25	4.73	16.40	71.46
203	6	994	9.60	10 00	1.25	4.04	14.10	70.92
226	6	208	12.60	13.40	1 51	5.96	16 00	83.75
234	3	1514	11.50	12 04	1.19	4.20	16.10	74.78
248	3	958	9.60	9.97	1.44	3.75	14.40	69.24
263	6	737	9.75	10 18	1.27	4 27	14.60	68.69
275	3	1278	9.10	9.45	1.47	3.73	14.50	65.10
282	6	460	11.40	12.07	1.63	5.52	17.30	69.76
284	3	835	13.65	14.17	1 27	4.39	17.30	81.90
318	3	1274	12 70	13.60	1.60	6.67	16.00	85.00
323	6	407	13.40	14.14	1.67	5.23	19.60	72.14
334	6	1050	9.70	10 26	1.85	5.45	15.00	68.40

KINGSBURY COUNTY,

Thirteen samples of seed were sent to this county and five packages of beets have been returned.

Sta. No. 136 was grown by W. A. Palmer, Denver township. No fertilizer was used and one half stand of crop was secured. Land plowed 8 inches; seed planted by hand; beets hoed, cultivated and thinned.

Sta. No. 156 was raised by Walter Thornber, Iroquois township. A good stand is reported. Land in cultivation 4 years; plowed deep in April and rolled. Beets cultivated, hoed and thinned. On account of drouth in early part of season the beets are not so good as they ought to be.

Sta. No. 174 was raised by R. Glendenning, Esmond township. No fertilizer and ninty five per cent stand are reported. Beets cultivated, hoed and thinned. Seed did not germinate until June 10. A hail storm on the 12 of August shattered the leaves badly and broke the stalks.

Sta. No. 180 was raised by D. M. Maxson, Esmond township. No fertilizer and very poor stand of crop are reported. Beets hoed once and cultivated three times. The ground was in corn last year was plowed in May, 8 inches deep and thoroughly dragged. The seed was sown with a drill, but the dry spell coming on only a few of the seed germinated until after June 1 and then the cut worms took them. After the shower at that time the balance of the seed came up but the worms were ravenously hungry and took all but about five per cent which was still farther reduced by dry hot winds that followed.

Sta. No. 186 came from F. W. Collins of De Smet. Land was in cultivation two years in potatoes and received a light coating of stable manure last year. Plowed in fall and again in spring 6 inches deep. Harrowed and planted seed by hand. Beets cultivated with hoe entirely. Weather dry with occasional rains.

The following tables finish the reports:

Station No.	Variety.	Planted.	Harvested.	Rows—inches	Beets in row—inches.	Tons per acre	Soil.
136	Desprez	May 4	Oct 6	40	8	13.0	Black loam.
156	....do	May 21	Oct 15	24	6	19.6	Sandy loam.
174	....do	May 13	Oct 13	36	12	8.5	Black loam.
180	....do	May 13	Oct 14	36	....	....	do
186	Klein Wanzlebener........ ..	May 7	Oct 17	16	10	21.8	do

ANALYSES:

Sta. No.	No beets analyzed.	Av wt grams.	Sugar in beet.	Sugar in juice.	Ash in juice.	Marc	Degree Brix.	Purity coefficient.
136	6	1038	11.30	11.84	1.38	4.58	16.80	70.49
156	6	951	12.00	12.53	1.22	4.23	16.60	75.48
174	6	673	10.40	10.87	1.33	4.32	16.40	65.66
180	6	716	9.60	10.02	1.39	4.23	15.00	66.80
186	2	922	12.60	13.26	1.14	5.04	18.00	73.67

JERAULD COUNTY.

Eleven samples of seed were distributed to this county and three samples of beets were returned. C. M. Yegge of Alpena reports his beets destroyed by cut worms.

August Bachmor, Crow Lake township sent in a sample (Sta. No. 378) after the laboratory was closed and it did not receive a complete analysis. In his case also the cut worms were very troublesome and the crop was practically destroyed. No. beets analyzed 6; av. wt. 250 grams; sugar in beet 14.25; sugar in juice 15.00; degree Brix 21.40; purity coefficient 70.00

Sta. No. 193 was grown by C. W. Parker, Blaine township. He had only one fourth stand on account of cut worms. In some places the beets were all gone for several feet and a short distance in the row would be all right. Av. wt. 701 grams; sugar in beet 10.80; sugar in juice 11.29; Ash 1.40; Marc 4.33; degree Brix 16.60; purity coefficient 68.01.

Sta. No. 256 was grown by W. C. Gordon, Franklin township. The beets were cultivated and hoed. The land was sandy loam. Beets 10 inches in row and rows 36 inches. Yield 8 tons per acre. Av. wt. 1161 grams; sugar in beet 11.70; sugar in juice 12.24; Ash 1.21; Marc 4.44; degree Brix 16.50; purity coefficient 74 18.

SANBORN COUNTY.

Nineteen samples of seed were distributed in this county and five samples of beets have been returned. C. D. Smith, Jackson township reports the loss of his beets by cut worms.

Sta. No. 138 was grown by Charles Ashton, Oneida township. No fertilizer and good stand of crop are reported. Beets were cultivated twice, hoed once and thinned.

Sta. No. 171 was grown by B.F. Wright, Warren township. Barn yare manure was used and only one fourth stand was secured owing to cut worms. Beets were plowed once and hoed three times.

Sta. No. 235 was grown by Hiram Phillips, Logan township. Barn yard manure was used and seven eighths stand was obtained. Beets were hoed twice, cultivated twice and thinned.

Sta. No. 332 was grown by S. F. Benson, Logan township. Barn yard manure was used and cut worms destroyed nine tenths of the crop.

These tables finish the reports:

Station No.	Variety.	Planted.	Harvested.	Rows—inches	Beets in rows—inches	Tons per acre.	Soil
138	Desprez	May 8	Oct 12	36	8	10.4	Dark loam.
171	....do	May 20	Oct 15	36	...	......	Clay mixed.
235	....do	do	Oct 12	20	8	22.0	Sandy loam.
332	....do	June 10	Oct 27	24	10	......	Sandy.

ANALYSES:

Sta. No	No. beets analyzed	Av. wt. grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
138	6	1225	12.80	13.38	1.50	4.35	18.00	63.22
171	7	764	9.20	9.61	1.45	4.43	13.70	70.07
235	6	1121	9.20	9.54	1.57	3.58	14.00	68.14
332	3	733	10.70	11.15	1.26	4.03	15.10	73.84

MINER COUNTY.

Five packages of seed were sent to this county and three samples of beets were returned. O. E. Clark of Roswell reports that cut worms destroyed his beets.

Sta. No. 163 was grown by M. Doty, Miner township. No fertilizer was used and nine tenths stand was obtained. The beets were cultivated and hoed.

Sta. No. 175 and 242 were grown by J. W. Briggs, Beaver township. No fertilizer was used this year, well rotted barn yard manure used last year. Seed planted with garden drill and beets hoed twice. Land was irrigated last winter from flowing well.

Sta. No. 209 was raised by George Basford, Miner township. Stable manure used and fair stand of crop reported. The seed was planted May 11 and the plants did not appear for over six weeks. Perhaps had he soaked the seed they would have come quicker.

The remainder of the reports follow:

Station No.	Variety.	Planted.	Harvested.	Rows—inches	Beets in rows—inches.	Tons per acre	Soil.
163	Desprez	May 8	Oct 14	30	10	21.5	Gray sandy loam
242	Desprez	May 16	Oct 15	20	12	39.6	Black sandy loam
175	Desprez	do	do	20	12	do	Black sandy loam
209	Desprez	May 11	Oct 14	30	8	3	Black

ANALYSIS:

Sta. No	No beets analyzed	Av wt. grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
163	6	1161	12.60	13.15	1.17	4.29	15.60	84.30
242	6	1083	10.20	13.13	1.54	4.87	17.80	73 20
175	3	626	12.50	10.63	1.43	4.05	14.10	75.39
209	6	1052	11.55	11.83	1.42	4.03	16.00	73.94

AURORA COUNTY.

Eighteen samples of seed were sent to this county and twelve samples of beets have been returned. One sample, Sta. No. 381, from C. L. Mott came too late for complete analysis.

Sta. No. 144 came from John Hage, Belford township. No fertilizer and fair stand of crop. Beets cultivated with cultivator and hoe.

Sta. No. 147 was grown by G. F. Merkle, Belford township. No fertilizer and half stand of crop. Ground plowed 8 inches deep, hoed the beets four times and cultivated them three times.

Sta. Nos. 225 and 229 were raised by A. H. Hall, White Lake township. No fertilizer was used and a fair stand of the first and a good stand of the second are given. This is the fifth crop from this plat of land; plowed 8 inches deep, dragged and rolled before planting. Planted with a hand drill, hoed the beets twice, cultivated twice and thinned.

Sta. No. 243 was grown by George E. Babcock, Centre township. The cut worms destroyed all but a few of the beets. Those left were kept clean from weeds.

Sta. No. 245 was grown by Herman Steffen, Belford township. Rotten manure was used and two thirds stand was obtained. Ground was very light drying out easy, on the top of a hill; plowed 14 inches deep and beets hoed twice. Cut worms destroyed part of the plants.

Sta. No. 302 was grown by Milton G. Swatman, Palentine township. A poor stand. For some reason nearly all the seed failed to grow. Perhaps they were planted too deep. After waiting for more of the seeds to grow until the ground got weedy plowed the field up with stirring plow, throwing the plow around those that had grown.

Sta. No. 348 was grown by J. B. Wheaton, Bristol township. Ground used for a garden for seven years and had always been plowed deep. No fertilizer and good stand.

Sta. Nos. 375, 376 and 377 were grown by D. G. Townsend, Plankinton township. No fertilizer was used and stand was not very even. Land plowed in the spring 8 to 12 inches deep, dragged and rolled and seed planted by hand and covered with team and plank. Cultivated three times, hoed and thinned.

These tables close the reports:

Station No.	Variety	Planted	Harvested	Rows — inches	Beets in row—inches	Tons per acre	Soil
144	Desprez	May 18	Oct 10	36	7	5.0	Black loam
147	...do	May 12	Oct 12	32	....	......	Light loam
225	White French	May 7	Oct 19	36	8	32.6	Black loam.
229	Desprez	do	do	36	8	17.3	....
243	Klein Wanzlebener	June 27	Oct 19	18	18	......	Prairie loam.
245	Desprez	May 20	Oct 15	22	7	20.0	Very light.
302	....do	May 23	Oct 28	24	....	......	Black loam
348	....do	June 15	Oct 30	36	8	5.0	Bottom land.
375	German	May 14	Oct 29	24	10	18.0	Black, 12 to 18 in. d'p
376	French	do	do	24	10	14.0	do
377	Improved White	do	do	24	10	20.0	do

ANALYSES:

Sta. No.	No. beets anlyzed.	Av. wt grams.	Sugar in beet.	Sugar in juice.	Ash in juice.	Marc	Degree Brix.	Purity coefficient.
144	6	1173	12.20	12.69	1.91	3.89	17.60	71.53
14	5	558	14.90	15.61	.92	4.64	18.30	82.02
225	3	1396	9.20	9.50	1.48	3.11	13.70	69.34
229	6	694	11.50	11.96	1.66	3.85	17.10	69.94
243	2	982	10.30	10 69	1.34	3.69	14.20	75.28
245	6	552	12.70	13 34	1.89	4.83	20.30	65.71
302	6	620	11.70	12.30	1.44	4.89	16.60	74.10
348	3	866	12.10	12 67	1.55	4.64	18.20	70.00
375	[illegible]	940	16.54	17.10	1.83	3.26	21.70	78.80
376	3	884	14.38	15.90	1.80	3.27	20.30	76.81
377	3	900	12.97	13.30	1.83	2.50	18.20	73.08
381	5	760	15.01	15.80	....	....	20.40	77.45

DOUGLASS COUNTY.

Three samples of seed were sent to this county and one sample of beets has been sent in.

Sta. No. 228 was grown by N. R. Wetlaufer, Independence township. The seed was planted May 21 and beets were harvested Oct. 19. Rows were 30 and beets 6 inches apart. No fertilizer and a good stand. The land was black prairie loam plowed 10 inches deep in May. Harrowed five times and planted seed by hand. Beets cultivated five times, hoed once and weeded. Land in use five years. The beets, variety, Desprez, average 639 grams; sugar in beet 11.80; sugar in juice 12.37; ash in juice 1.12; marc 4.61 degree Brix 17,00; purity coefficient 72.76; yield per acre 56 tons.

HANSON COUNTY.

Ten samples of seed were distributed and three samples of beets were returned.

Sta No. 187 was grown by L. L. Brande, Edgerton township. The beets were planted May 15 and harvested Oct. 13. The rows were 36 inches and the beets 6 to 8 inches. The stand of crop was poor. Beets were hoed and plowed. Land a sandy loam.

Sta. No. 250 was raised by Joseph Lunn, Pleasant township. The beets were planted May 16 and harvested Oct. 12. The poor stand was caused by dry weather at planting time and cut worms at thinning out time. Attempted to transplant the beets but those tried never made any growth to speak of.

Sta. No 285 was grown by Thomas Scholfield, Hanson township. Beets were planted May 12 and harvested Oct. 20. A little hog manure was mixed with the soil. The seeds were planted thickly and came up very nicely, but the worms took nearly all of them shortly after they came up. He only raised 100 beets and they were scattered over one and one half rods of ground. Av. wt of the one hundred raised 3.4 pounds.

The following analysis complete the report.

Sta. No.	No. beets analyzed.	Av wt grams	Sugar in beet.	Sugar in juice.	Ash in juice	Marc.	Degree Brix.	Purity coefficient.	Variety.
187	6	374	9.60	10.07	1.06	4.65	15.40	65.39	Desprez
250	6	1361	9.20	9·53	1.47	3.46	14.20	67.11	do
285	3	1145	14.30	15.01	1.50	4.73	17.90	82.85	do

DAVISON COUNTY.

Eleven samples of seed were given out in this county and five samples of beets were returned. A. W. Hubbard of Mitchell lost his crop. Stock ate the beets in September.

Sta. No. 172 was grown by J. C. Clapham, Blendon township No fertilizer and three fourths stand. Land plowed 12 inches deep and beets cultivated by hand.

Sta. No. 205 came from George Calkins, Badger township. No, fertilizer was used and stand, good. Beets cultivated and hoed

Sta. No. 214 was grown by John Abraham, Beulah township. Barn yard manure was used and not very good stand was obtained. Beets were hoed.

Sta. 251 came from Gottfried Wilde, Baker township. No fertilizer and a very good stand are reported. Ground plowed deep in Autumn and beets hoed and kept free from weeds. The cut worms took most of the beets. Beets cultivated as in Germany.

Sta No. 258 came from Ben. B. Perley, Badger township. The crop was mostly destroyed by cut worms.

These tables finish the reports.

Station No.	Variety	Planted	Harvested	Rows—inches	Beets in row. inches	Tons.per acre	Soil
172	Desprez	May 12	Oct 15	24	6	10.0	Black loam.
205	....do	June 8	Oct 15	26	7	19.0	do
214	....do	June 1	Oct 15	36	7	6.2	Black sandy loam.
251	... do	April 29	Oct 5	24	....	......	....
258	....do	May 18	Oct 23	48	....	......	Black sandy loam.

ANALYSES:

Sta. No.	No. beets analyzed.	Av. wt. grams	Sugar in beets	Sugar in juice,	Ash in juice.	Marc	Degree Brix	Purity coefficient.
172	6	1141	10.00	10.42	1.04	4.04	14.20	73.38
205	6	531	15.10	15.76	.97	4.19	18.20	86.59
214	6	261	14.50	15.21	1.03	4.71	19.00	80.53
251	6	818	13.85	14.40	1.19	4.67	18.10	79.56
258	8	210	13.80	14.49	.84	4.73	17.00	85.24

HUTCHINSON COUNTY.

Ten samples of seed were distributed and four samples of beets were returned from this county.

Sta. No. 151 came from Nathan Osborn, Liberty township. No fertilizer and good stand. Land plowed 12 inches deep and beets plowed once and hoed twice.

Sta. No. 200 came from C. Stickel, township 67. No fertilizer and a good stand. Beets cultivated.

Sta. No. 286 came from John Fish, Township 99 R. 60. No fertilizer and a fair stand of crop are reported. Beets cultivated once and hoed twice.

Sta. No. 362 came from John A. Brown, Township 98. No fertilizer and a good stand are given. Beets cultivated and hoed.

The following tables complete the reports:

Station No.	Variety.	Planted.	Harvested.	Rows—inches	Beets in row—inches.	Tons per acre	Soil.
151	Desprez	May 15	Oct 12	36	4	43.6	Deep black loam.
200	....do	May 5	Oct 7	36	6	10.0	do
286	....do	May 6	Oct 15	....	8	......	Black loam.
352	....do	June 1	Oct 15	18	4	62.0	Good but dry.

ANALYSIS:

Sta. No.	No. beets analyzed.	Av. wt. grams.	Sugar in beets.	Sugar in juice.	Ash in juice.	Marc.	Degree Brix.	Purity coefficient.
151	6	1206	8.50	8.81	1.91	3.52	14 40	54.38
200	3	1267	10.20	10.61	1.76	3.90	15.50	68.45
266	6	1154	8.30	8.68	1.50	4.03	13.10	66.26
352	6	600	13.00	13.54	1.32	3.99	16.50	82.06

In general there has been a great interest in this work throughout the James River Valley and especially so in certain centres that are looking forward to beet sugar factories. Some very good results have been obtained and when better cultivation is learned and practiced good results will be the rule and not the exception.

THE MISSOURI VALLEY REGION.

CAMPBELL COUNTY.

Two samples of seed were sent to this county and both farmers receiving them returned samples of beets.

Sta. No. 281 was grown by James Reid, Auburn township. No fertilizer was used this year, last year barn yard manure for potatoes. Stand was good. Plowed ground 8 inches deep, made furrows with shovel plow and sowed seed by hand. Beets cultivated and hoed. "The drills were broad and in many places the beets grew in a mass, one jammed against an other. Some of the beets are creased on account of coming in contact with one another. I do not want any more sugar beets to experiment with. I am doubtful if they will pay here either for sugar or for cattle food. Labor is too high priced and corn is cheaper for stock. I raised a few beets for a sugar factory in San Francisco, Cal. last year. They showed 16 per cent of sugar. I have also raised beets other years and there is no longer any question about their growing here and of good quality. When the heat and drought in July affected wheat quite seriously, the sugar beets grew right along. We had some heavy rains this fall that may have affected the quality."

Sta. Nos. 330 and 331 were grown by Myron T. Wolverton, Franklin township. No fertilizers were used and the stand was fair. The first was grown on low ground and the second on ground two feet higher, and drier. The beets were cultivated once and hoed once. The beets grown on higher ground were rather better for sugar making owing to a higher purity coefficient and lower ash.

The following tables complete the report:

Station No.	Variety	Planted	Harvested	Rows—inches	Beets in row—inches	Tons per acre	Soil
281	Desprez	May ..	Oct 17	30	....	12	High moder'ly fertile
330	....do	May 10	Oct 21	20	10	15	Black loam.
331	....do	do	do	20	10	15	.....do ....

ANALYSIS:

Sta. No.	No. beets analyzed.	Av. wt. grams.	Sugar in beets.	Sugar in juice.	Ash in juice.	Marc.	Degree Brix.	Purity coefficient.
381	6	529	14.10	14.82	1.37	4.88	18.10	81.87
330	6	620	15.20	16.05	1.33	5.30	19.80	86.12
331	6	737	15.20	15.86	1.19	4.80	18.00	88.11

WALWORTH COUNTY.

But one sample of seed was sent to Walworth county, and the recipient, A. Johnson reports that the long legged potato bugs destroyed the plants.

POTTER COUNTY.

Seventeen samples of seed were distributed to this county and eight samples of beets were returned. A. E. Beaudoin of Lebanon reports a failure for unknown reasons.

Sta. No. 137 was grown by S. G. Manful, Lowell township. No fertilizer used and a good stand of crop. Beets cultivated with common corn plow and hoed once. "I find them excellent for stock. Sheep and pigs do well on them. They are easy to cultivate and I want to raise one or two acres next year. I can raise 2,500 bushels per acre with lfttle trouble."

Sta. Nos. 123, 150 and 162 were grown by James Naylor, Jr., Artichoke township. Barn yard manure was used and stand was fair. Land plowed 10 inches deep. Beets cultivated once and heed three times.

Sta. No. 164 was raised by Chas. O'Neill, Logan township. No fertilizer and a good stand. Land cultivated five years; last crop flax. Beets cultivated once and hoed once. "They will more than pay me for my labor for feeding to my stock."

Sta. No. 194 was grown by W. E. Scanlon, Lucas township. No fertilizer and thin stand. Beets cultivated twice and hoed once.

Sta. No. 196 was raised by J. B. Roberts, of Potter. No fertilizer and very poor stand. Beets cultivated and hoed.

Sta. No. 259 was grown by Wm. H. Spencer, Artichoke township. An inch of sheep manure was used and stand of crop was good. Ground plowed deep in the spring and beets were cultivated twice and hoed three times.

The following tables finish the reports:

Station No	Variety	Planted	Harvested	Rows—inches	Beets in row—inches.	Tons per acre	Soil
137	Desprez	May 15	Oct 4	44	9	45	Bunch grass, clay and
123	....do	May 8	Oct 9	20	8	10	Sandy loam. [sand.
150	German	do	do	20	8	10	do
162	White Globe	do	do	20	8	8	do
164	Desprez	May 10	Oct 14	36	6	9	Black sandy loam.
194	....do	May 15	Oct 13	36	6	6	Bunch grass b'k lo'm
196	... do	May 25	Oct 17	36	..	..	....
259	....do	May 13	Oct 17	36	9	8	Yellow bunch grass.

ANALYSES:

Sta. No.	No beets analyzed	Av. wt. grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
137	3	1306	8.80	9.10	1.58	3.38	13.40	67.16
123	5	598	13.10	13.66	1.62	4.23	19.00	71.90
150	7	297	12.30	12.88	1.52	4.65	18.40	70.00
162	5	303	16.50	10.98	1.37	4.41	16.00	68.63
164	6	741	11.50	12.16	1.24	4.30	17.80	67.20
194	6	821	12.15	12.69	1.25	4.29	17.00	74.43
196	6	1268	9.00	9.34	1.58	3.82	14.00	66.48
259	6	682	12.80	13.46	1.38	4.90	17.30	77.80

SULLY COUNTY.

Nineteen samples of seed were sent to this county and five samples of beets have been returned. Miss Minnie Hock of Clifton, and Geo. G. Howard of Elk township lost their plants by drought. John A. Buck of Pearl township lost his beets by hail on the third of July. F. E. Fagner, Ojoboko, sent a sample, Sta. No. 380 too late for complete analysis.

Sta. No. 128 was grown by J. R. Knapp, Morton township. No fertilizer used. Beets hoed and kept clean from weeds. This sample was not ripe when harvested.

Sta. No. 132 was grown by Mrs. W. H. Reed, Norfolk township. A medium stand of crop. She writes: "This is my first attempt. I planted May 8 and did first thinning June 15th. The beets grew nicely during the first two months, every seed seeming to come up. July 4th, dry weather set in and we had no more rain to speak of. They grew very slowly after the dry weather began. They were planted on oats ground, plowed deep, the soil being mellow and of rather sandy nature. I am confident that deep plowing is necessary in all cases with a reasonable amount of moisture. We had frost the latter part of August killing all kinds of vines. I could improve the growth at another trial. I have always heard they were not good for cooking, but I find them as palatable as the red beet."

Sta. No. 283 was raised by Nathan Porter, Hartford township. No fertilizer used and a good stand. Beets cultivated once and kept perfectly clean from weeds with hoe.

Sta. No. 349 was grown by G. F. Burtch, Onida township. No fertilizer used and although plenty of rain fell the seed germinated unevenly. The leaves were cut by hail twice. He intended to irrigate the beets but it was not necessary. The splendid results shown by the analysis show what a hardy plant the sugar beet is.

These tables complete the reports:

Station No.	Variety.	Planted.	Harvested.	Rows—inches	Beets in row—inches.	Tons per acre	Soil.
128	Desprez	May 4	Sept 25	20	6	9	Black loam.
132	....do	May 8	Sept 25	46	8	24	Sandy.
283	... do	May 20	Oct 13	36	6	28	Black
349	....do	May 14	Oct 17	26	18	24	Black Sandy loam.

ANALYSES:

Sta. No	No beets anlyzed	Av. wt grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
128	6	327	13.19	13.78	1.80	4.97	10.00	72.52
132	8	146	13.40	14.14	.97	5.24	18.20	77.60
283	6	497	11.40	11.95	1.37	4.62	15.90	75.16
349	3	1089	17.00	17.90	1.55	5.57	20.80	86.05
380	6	510	14.25	15.00	....	....	18.30	82.00

HYDE COUNTY.

Fourteen samples of seed were sent to this county and one package of beets were returned. Sta. No. 340, variety Desprez was grown by John Shearer, Highmore township. He reports a poor stand on account of cut worms, land in cultivation seven years and last crop millet. The av. wt. was 287 grams; sugar in beet, 16.45; sugar in juice, 17.29; ash in juice 1.19; marc 4.89; degree Brix 19.80 and purity coefficient 86.82.

The beets were planted in rows 24 inches apart and the beets thinned to 6 to 8 inches. But the cut worms spoiled the experiment. The analysis shows that very rich beets might be grown. He also sowed some seed forty two inches apart but they grew too large.

HUGHES COUNTY.

Eleven samples of seed were sent to this county and four packages of beets were returned. A. G. Swanson of Dry Run township and George Chadwick of Harold assign dry weather as the reason for the failure of their beets.

Sta. No. 139 was raised by J. P. Youngberg, Logan township. No fertilizer used and stand poor. Ground broken in 1890, Beets cultivated and hoed.

Sta. No. 207 was grown by Mrs. A. H. Whaley, Harrold. The beets were irrigated with artesian water. Cultivated with hoe. Probably the beets were kept growing too long. No water should have been supplied after Sept. 1. The rows were ridged up and water from the artesian ditch was let in. They grew very large. There were no small ones.

Sta. No. 271 was grown by D. A. Arnold of Blunt. Ground plowed deep; beets hoed three times and kept clean from weeds. Seed did not germinate well; too dry. Quite dry all through the season.

Sta. No. 322 was raised by E. R. McQueen, Harrold township. Manured last year with barn yard manure. Beets were hoed.

The following tables complete the reports:

Station No.	Variety	Planted	Harvested	Rows—inches.	Beets in Row—inches	Tons per acre	Soil
139	Desprez	....	Oct 13	....	....	......	Black loam.
207	Vilmorin's Improved	May 25	Oct 10	24	9	36	Sandy loam
271	....	May 10	Oct 12	24	....	......	Dark sandy loam.
327	Desprez	May 1	Oct 15	12	8	29	Dark clayey soil.

ANALYSES:

Sta. No.	No. beets analyzed	Av. wt. grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
139	6	582	11.20	11.75	1.59	4.69	16.20	72.22
207	3	1143	8.70	9.07	1.71	4.11	14.40	62.99
271	6	674	12.20	12.86	1.34	5.13	16.50	77.95
322	4	819	11.80	12.41	1.62	4.19	16.90	78.25

BUFFALO COUNTY.

Ten packages of seed were distributed to this county and five samples of beets were returned. H. Klindt of Grant township lost his plants by cut worms. Alfred J. Wooledge of Gann Valley raised a good crop but neglected to send a sample.

Sta. No. 134 was grown by Mrs. Z. A. Johnstone, Eden township. Ashes and refuse were used as fertilizers and a good stand of crop was obtained. The beets were hoed.

Sta. No. 157 was grown by Wm. K. Brown, 107-68. Manure was used last two years previous and an uneven stand is reported owing to cut worms. Beets were cultivated and weeded by hand.

Sta. Nos. 303 and 304 were grown by Wm. Cruson, Eden township. No fertilizer and sixty per cent stand are reported. Beets were cultivated with hoe.

Sta. No. 317 came from John B. Smith, Elmira township. No fertilizer and good stand. Beets cultivated twice and hoed twice. Kept clean from weeds.

These tables complete the report:

Station No	Variety	Planted	Harves'ed	Rows—inches	Beets in row—inches	Tons per acre	Soil
134	Desprez	May 10	Oct 8	18	6	53	Black loam.
157	....do	May 12	....	48	....	......	Best prairie.
303	....do	May 15	Oct 19	24	3	12	B't'm land with sand
304	Vilmorin	do	do	24	3	15	do
317	Desprez	June 12	Oct 14	42	7	4	Black prairie loam.

ANALYSES:

Sta. No	No beets analyzed	Av. wt grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
134	6	450	16.30	17.11	1.60	4.76	21.80	78.48
157	6	787	10.10	10.54	1.55	4.21	15.40	68.44
303	6	662	13 50	14.06	1.35	4.00	16.80	83.69
304	6	905	16 20	17.05	1.22	4.99	18.60	91.67
317	6	354	17.20	18.34	1.67	6.30	21.80	84.13

BRULE COUNTY.

Eleven samples of seed were distributed in this county and five samples of beets have been sent in. F. H. Griswold, Smith township lost his beets by cut worms.

Sta. No. 183 was grown by Simon Morgan, Pleasant Grove township. "The soil was not in good condition as I plowed it last fall for a fire break and the ground was too dry. Beets hoed three times. Was not prepared this year but will do better next year."

Sta. Nos. 252 and 253 came from J. C. Victoria, Smith township. No fertilizer and good stand. Plowed May 13; harrowed twice hoed and thinned one week after plants appeared, then cultivated twice after that.

Sta. No. 141 came from Charles Schwiesow, 105-70. No fertilizer and light crop. Beets cultivated twice and hoed once.

Sta. No. 142 was grown by Patrick Rigney, Red Lake township. No fertilizer and beets cultivated with horse cultivator.

The following tables finish the reports:

Station No.	Variety	Planted	Harvested	Rows—inches.	Beets in Row—inches	Tons per acre	Soil
141	Desprez	May 8	Oct 9	44	12	22	High land heavy soil.
142	....do	May 16	Oct 8	30	8	26	Clayey.
252	....do	May 14	Oct 14	30	12	14	Deep black sand.
253	French Yellow	do	do	30	12	20	do
183	Desprez	May 18	Oct 12	24	6	32	....

ANALYSES.

Sta. No.	No. beets analyzed	Av. wt. grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
141	5	1992	9.80	10.18	1.54	3.75	15.00	67.86
142	6	950	10.00	10.42	1.77	4.02	16.20	70.49
183	6	750	13.80	14,45	1.32	4.50	18.60	77.69
252	6	1150	10.10	10.50	1.16	3.81	14.40	72.91
253	1	1737	9.60	9.98	1.10	3.83	13.30	75.04

CHARLES MIX.

Three samples of seed were sent to Charles Mix county and one sample of beets were sent in. Sta. No. 333, Dieppe's Klein Wanzlebener, was grown by J. C. Samuel, Castalia township. Seed planted June 1 and beets harvested Oct. 27; rows 42 inches apart and beets six inches in the row. The stand of crop was good and the pield 33 tons per acre. No fertilizer; clay soil; cultivation same as corn except one hoeing and thinning. Av. wt. 1240 grams; sugar in beet 14.00; sugar in juice 14.65; ash in juice 1.63; marc 4.43; degree Brix 16.90; purity coeffiicient 86.68; 3 beets analysed.

BON HOMME COUNTY.

Thirty two samples of seed were sent to this county and three samples of beets were returned.

Sta. No. 182 was grown by Joseph Horkey, 96. A good stand of beets which were hoed twice.

Sta. No. 279 was grown J. Jiricek, 95. Beets hoed twice.

Sta. No. 289 was grown by Charles C. Reynolds, 95 R. 59. No fertilizer and one third stand. Hoed once and plowed once with corn plow.

The following tables complete the reports:

Station No	Variety	Planted	Harvested	Rows—inches	Beets in row—inches.	Tons per acre	Soil
182	Desprez	May 15	Oct 6	24	12	10	Heavy dark clay.
279	....do	May 5	Oct 7	20	9	12	....
289	....do	May 10	Oct 22	42	....	......	Upland, second crop

ANALYSES:

Sta. No.	No beets analyzed	Av. wt. grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
182	4	1721	8.60	8.91	1.59	3.53	13.40	66.49
279	5	924	13.30	13.98	1.24	4.87	18.30	76.50
289	3	996	11.50	11.94	1.21	3.81	14.60	81.80

YANKTON COUNTY.

Three samples of seed were sent to this county and one sample of beets was returned.

Sta. No. 310, Desprez, was grown by James Connell, 93. The seed was planted May 15; harvested Oct. 16; rows 24 inches; beets 6 inches in row; good stand; yield per acre 30 tons; Barn yard manure applied; light sandy loam in cultivation 20 years; last crop corn; beets cultivated twice and hoed twice. 4 beets analyzed; av. wt. 1001 grams; sugar in beet 11.40; sugar in juice 12.08; ash 1.12; marc 5.69; degree Brix 13.80; purity coefficient 87.53.

CLAY COUNVY.

Five samples of seed were sent to this county and two packages of beets were returned.

Sta. No. 181 was grown by Thomas Jordan, Fairview township. No fertilizer was used. Beets planted on old ground which had been cultivated 30 years. Has never been fertilized. The beets were hoed once and cultivated once. "The beets were planted in a far corner of the lot and were forgotten. They did not come up till late in June and I did not think they would amount to much and so did not tend them as they should have been. Later in the season it rained too much."

Sta No. 305 came from J Hvestendahl, Prairie Centre township No fertilizer was used Land in use three years Last crop potatoes. Beets cultivated and weeded by hand.

The remainder of the reports are given below:

Station No.	Variety	Planted	Harvested	Rows—inches	Beets in row, inches	Tons per acre	Soil
181	Klein Wanzlebener..........	May 27	Oct 16	46	*	......	Sandy loam.
305	Desprez	May 14	Oct 20	....	8	......	Sandy and blue

*Too thick.

ANALYSES:

Sta. No.	No. beets analyzed.	Av. wt. grams	Sugar in beets	Sugar in juice,	Ash in juice.	Marc	Degree Brix.	Purity coefficient.
181	6	1721	10.70	11.12	1.30	3.79	14.50	76.69
305	4	1101	10.10	10.58	1.21	5.56	15.50	68.26

UNION COUNTY.

Two samples of beets were received from this county G Nilson, Virginia township, reports his beets planted late and destroyed by cut worms.

Sta No. 240 was raised by O. Whitney in Sioux Valley township. Beets were planted May 10 and harvested Oct. 6. Soil black loam; beets hoed; variety, Desprez.

Sta. No 290 was grown by A. P. Johnson, Sioux Valley township No fertilizer and very thin stand Black loam, quite rich; beets cultivated same as corn but were thinned.

The analyses follow:

ANALYSES:

Sta. No	No beets analyzed	Av wt. grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
240	6	778	10.50	10.94	1.32	3.99	15.50	70.58
290	3	1072	13.20	13.89	.86	5.02	16.60	83.70

GREGORY COUNTY.

One sample of beets came from Gregory county west of the the Missouri river.

Sta No 238 was grown by D. H Gaughen of Huson Beets planted May 21; harvested Oct. 15. Rows 24 inches; beets in row 8 inches Stand good; yield 12 tons; no fertilizer; soil black sandy; beets hoed and plowed. Variety, Desprez. 6 beets analyzed, av wt. 768 grams; sugar ie beet 15 10; sugar in juice 15.80; ash in juice 1.05; marc 4.47; degree Briz 19 80; purity coefficient, 79.80.

The results are in general good for this region.

THE BLACK HILLS REGION.

Seven ssmples in all have been analyzed from the Black Hills. Three of these samples have fallen to medium grade or below The others are excellent and would be most acceptable at any sugar factory.

Sta No. 368 is supposed to come from Andrew Craig, Vale. Butte county. Barn yard manure was used the previous year and the stand was rather poor. Weather very dry at time of planting; heavy rain May 30. Beets plowed once with shovel plow and hoed three times and kept clean from weeds.

Sta. No. 195 was grown by Hugh Breslin, Spearfish, Lawrence county Seed sown by hand drill and cultivated with the attachments for same at first Also hoed by hand and weeded fairly well. Mr. Breslin writes: "With thorough cultivation, I believe the crop of sugar beets in this locality would be simply immense If the sugar beet is rich enough in sugar all we want is a large sugar beet factory in Spearfish. I will warrant capital and all the sugar beets that may be needed for a plant in Spearfiish, and an excellent home market for the sugar in the mining regions in our midst."

There can be little doubt that as rich sugar beets can be grown there as any where in the country. Mr. Breslin's sample was rather too large to carry a high per cent of sugar. Had he followed directions closer and sent smaller and averaged sized beets his showing would have been better and the results nearer the truth. But the third sample from Spearfish is far above either the French or German average.

Sta. No 212 was grown by John Breslin, Spearfish. No fertilizer was used and a fair staud. Cultivated as last sample. "We had some hail storms that hurt the beets to some extent;

but nevertheless they yielded well." This would have put off the time of ripening and probably both this sample and the preceding one would have done better had they been left growing two weeks longer.

Sta No 342 came from J. S Pratt, Spearfish. No fertilizer and a poor stand, owing to failure of some of the seed to germinate, are given. Beets hoed. No data are given so that the yield could be computed.

Sta. No. 213 was grown by John Twining, Folsom, Custer county. No fertilizer and good stand Cultivated with a hand cultivator. It was very dry till the 5th, of July when we had a hail storm that beat the tops all off the beets Two weeks later we had another rain. Since then it was dry.

Sta. No 127 was grown by J. D Margareidge, Buffalo Gap, Fall River Co. No fertilizer and full stand. Hoed twice.

Sta. No. 374 was grown by Thomas Colgan, Oehlrichs, Fall River Co. No fertilizer and a full stand. Land cropped successively with corn, cabbage, potatoes and sugar beets Seed planted by hand. Beets hoed twice.

J. A. Ball, Maitland, reports seven tons to the acre, but his sample did not reach the station.

The following tables complete the reports:

Station No.	Variety	Planted	Harvested	Rows—inches.	Beets in Row—inches	Tons per acre	Soil
368	Desprez....................	May 27	Oct 32	36	2–60	17	Black sandy loam.
199	....do	May 8	Oct 16	24	3–8	14	Black loam.
212	....do	May 6	Oct 15	24	7	15	Bl'k l'm, sandy rocky
342	....do	May 15	Oct 20	24	....	......	Sandy loam. [subsoil
213	....do	May 8	Oct 15	18	8	22	do
127	....do	May 18	Oct 8	24	6	20	do
374	....	May 12	Oct 28	30	8	12	Clay table land.

ANALYSES:

Sta. No.	No. beets analyzed	Av. wt. grams	Sugar in beet	Sugar in juice	Ash in juice	Marc	Degree Brix	Purity coefficient
368	6	508	16.30	17.37	1.36	6.16	22.30	77.89
195	6	1016	11.05	11.58	1.31	4.14	15.10	71.62
212	6	942	11.05	11.59	1.28	4165	16.60	69.82
342	5	363	17.00	18.35	1.67	6.32	22.20	82.61
213	6	548	16.00	16.92	.92	5.46	20.60	82.14
127	6	1172	8.70	9.02	1.39	3.60	14.10	64.00
374	6	662	16.47	17.00	1.17	3.12	19.70	86.29

GENERAL SUMMARY.

1. With good cultivation sugar beets with a high per cent of sugar, a good purity coefficient, a large yield per acre and in every way adapted for sugar manufacture can be grown in most parts of South Dakota.

2. The soil of this state is second to none in respect to the ease with which it may be cultivated

3. No fertilizer would be necessary, with a judicious system of rotation for years to come, so far as the sugar beet crop is concerned. The raising of sugar beets would be a benefit to the land.

4. The fertility of the soil makes it imperative that the rows of beets be planted as closely as commercial cultivation will allow. The beets also must stand closely in the row, not to exceed six or seven inches This will not only insure, a valuable beet for the manufacturer but will also insure the farmer large returns per acre.

5. The seed must be planted as early as possible in the spring so that the plant may have a good start before the heat of summer comes on. Also the beet must reach maturity before it is sampled for analysis. If the ground be dry at time of planting, germination may be hastened by soaking the seed for twenty four hours in equal parts of water and urine or water to which a small amount of salt petre has been added. The seed may be rapidly dried for sowing by exposing for a short time, in thin layers spread out on paper, to wind and sun.

6 The work is now at a point where careful preparation of the soil and proper planting and careful culture are the factors mostly needed.

7. The work will be carried on another year. The Station will bear all expense on account of seed, and transportation of samples, etc. The cultivator runs no risk as the beets are valuable for stock food and he is gaining experience with a crop that may be at no distant day a most valuable one for him to raise.

Four hundred samples of the very best imported seed will be distributed this spring. But seed will be sent only to those who ask for the same and who will agree to follow directions for cultivation. Write for the seed immediately upon receipt of this Bulletin. Should more than four hundred applications be received, those first received will get the seed. This will be a fine opportunity to obtain pedigreed seed free of cost.

All correspondence in regard to sugar beets should be sent to Jas H Shepard, Brookings, S D., Chemist of the Station.

SOUTH DAKOTA

AGRICULTURAL COLLEGE

AND

EXPERIMENT STATION

BROOKINGS, S. D.

BULLETIN NO. 28.

DECEMBER, 1891.

DEPARTMENT OF AGRICULTURE.

IRRIGATION.

DUTCHER & BREED, BROOKINGS

GOVERNING BOARDS.

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The Bulletins of this Station will be sent free to all residents of the State who will apply for them.

Mail for the Station should be addressed to the Director, and that for any special department to the officer in charge.

IRRIGATION.

Luther Foster, Director. Chas. A. Duncan, Irrigator.

The subject of irrigation is of great importance to the people of South Dakota, and especially so to those living in the strip of country known as the "James River Valley."

This strip lies in the great artesian basin of the Dakotas and wherever wells have been put down to the water bearing strata, water has been obtained in abundance. But the people in general, are unacquainted with the methods and effects of irrigation and many questions arise regarding it. Some of the most important of these questions are as follows: Will it pay to put down an artesian well for the purpose of irrigation? How much water will be required to irrigate a certain area of land? How can water be distributed over the land? When to irrigate and how much water do certain crops require? Will the artesian water be injurious to vegetation? Will the filling of natural reservoirs and channels increase the precipitation enough to insure a crop?

It is not only the object of this bulletin to give the results of the experiments carried on by the Experiment Station, in irrigation and to answer as best we can these questions, but, to give as well, some ideas regarding fall and winter irrigation and a decription of some of the methods used in Colorado and other states which may be of use in this state.

Are Wells Profitable?—Will it pay to put down wells for irrigation? The soil is very productive when there is sufficient moisture, and of course should be very valuable, but where crops cannot be depended upon, the value of the land is greatly diminished. With water for irrigation, land is insured from drouth. A comparison ofthe cost price of land here with the irrigated land of other states shows that the increase in value would be enough to put down the wells.

In Colorado improved land with a perpetual water right is worth from $40.00 to $100.00 an acre, while in other states the price is still higher. A perpetual water right for 80 acres of land in Colorado is worth $2000.00. As the water supply depends on the snow fall in the mountains it is to some degree uncertain. Many of the canals can only furnish water during the high water season so the only crops which can be raised are those which depend only on water during the early summer.

The wells of South Dakota flow from 500 to 3000 gallons per minute and this flow is throughout the year, giving the advantage of having water for irrigation at any time desired.

The value of these wells may be increased by storeage reservoirs and by utilizing their water power. In cost they vary from $2,000.00 to $5,000.00. Compared with a water right in Colorado, a well privilege would be worth from $2,000.00 to $12,000.00, depending on its flow; and this would be true if the well only flowed for three or four months during the growing season.

AMOUNT OF WATER REQUIRED--A question frequently asked is, how much water will be required to irrigate a section of land? This depends to some extent on the surrounding circumstances. The amount will vary with different soils, different crops and the annual rainfall. It is estimated in Colorado that a constant flow of 450 gallons per minute through the irrigation season (ninety or one hundred days) will irrigate thoroughly only fifty-five acres. This amount would cover the ground to a depth of between forty and fifty inches. To those unaccustomed to irrigation this seems unnecessary and is undoubtedly more than the actual amount of water applied. The supply of water from the mountain streams decreases from the first of July until the irrigating season is over, so the amount of water used by the consumer diminishes with the decrease. Crops can be produced with much less water, but the yield will not be as great as the land would produce if thoroughly irrigated. In Italy the duty of a flow of 450 gallons per minute during the irrigating season is seventy acres. This is where they have had 600 years experience and with an annual rainfall of thirty-six inches. Land which is irrigated for the first time will require more water, as the lower depths must be saturated. Comparatively level land will require more water than sloping land as the spread is slower, so that more of the water is absorbed by the lower depths. Judging from the experience with irrigation in this state, it is safe to say that a well with a flowing capacity of 2000 gallons per minute, will furnish an abundance of water for a section of land.

This may not be obtained during the first two years as the ground requires more water at the start. A knowledge regarding the lay of the land with some experience in distributing the water would also be necessary to accomplish it.

Distribution of water.—The methods of distributing the water over the land are at present receiving a great deal of attention especially where the supply is limited, the object being to increase the duty of water.

In preparing a field for irrigation the location of the well should be selected with the view of securing a good site for a reservoir as well as the least expense in the construction of mains for carrying water to different parts of the field. Although a reservoir is not really necessary, no system of irrigation by artesian wells can be perfect without one. The best form for a reservoir is a circle or an ellipse. Either of these forms saves unnecessary construction of embankment and will, to a certain degree, overcome the erosion caused by the action of the waves. The embankment should be seven feet high with a slope of two to one on the inside and one and a half to one on the outside, 29 feet wide at the base and 4 feet wide on the top.

The size of a reservoir should vary from three to ten acres according to the amount of land to be irrigated. The mains or ditches should be laid out carefully with reference to the lay of the land. If the field has a general slope the mains should be placed along the highest side, or if it has a ridge running through it the mains should be placed on this if the fall is convenient. But where the unevenness will not permit this arrangement it should branch, keeping up as much as possible on the sides of the ridge. The fall necessary for a main as ordinarily built is over four feet to the mile. When the fall is less than this the width of the main must be increased. A ditch having a fall of four feet to the mile, would need to be five feet wide and a foot and a half deep to carry a flow of two thousand gallons per minute.

In constructing mains it is sometimes necessary to raise the banks or build flumes to get the water to certain parts of the field. When the rise is more than four feet above the ground it is cheapest to flume it to the desired point.

In Colorado an embankment is thrown up for the purpose of carrying water above the surface of the ground and is called a dike. The method of construction is to throw up an embankment the same as for a railroad grade, giving it the proper fall; a channel is then made on the top of this grade through which the water passes. The method most used in the artesian basin of Dakota is to throw up two embankments. The earth necessary for the construction is taken from between them. This makes a wide space between the two embankments necessary. The disadvantage to this arrangement is the loss of water which remains between the banks and in the excavation formed by their construction. It is however, the only practical way in this state on account of the peculiar condition of the soil. In constructing these banks the same slopes are used as in the embankment of a reservoir. Flumes may be placed on ordinary trestle work which should vary in strength, depending on the volume of water to be carried. A flume 18 inches wide and a foot in depth with a slight fall will carry all the water that flows from an ordinary well. It should be well braced and this can be done by placing two-by-fours, three or four feet apart all around it. The joints should be placed over the trestles. After everything has been arranged for carrying the water to different parts of the field, before it is ready for irrigation, laterals will have to be made. Sometimes these are made permanent, but as a general rule they are used for but one season. When not intended to be permanent they are run soon after the crop has been put in. The method of running and the construction of these laterals depends entirely on the lay of the land. When there is a general slope having a fall of from four to twenty feet to the mile, the laterals are run diagonal to the direction of the general slope and are made by plowing a single furrow, throwing it to the lower side or with the fall. The distance apart the laterals are placed varies from 50 to 150 feet. A field irrigated in this way is represented in figure 1. Permanent laterals are placed twenty rods apart and are constructed by plowing four furrows, throwing the two inside furrows on the two outside furrows to make the banks, as represented in the middle in Fig. 1. The same rule is followed when permanent laterals are made for the whole field. The objection here is that the field is cut into small strips which makes it inconvenient.

If there are ridges running through the field a main lateral should be placed on each one and from these, branch laterals run. The same rule is followed as in sloping land, that is, to run them diagonal to the general slope of the sides of the ridge as represented in Fig.2. When hill points are to be irrigated the laterals are kept as nearly as possible on the line dividing the slope. These laterals are made by throwing a furrow both ways. What is known as a double mould board plow is used for running them. When there is too much land to be irrigated from one of these, branch laterals are run.

In irrigating, water is turned into three or more laterals, depending on the amount of water in use. Dams are then thrown in near the main. The water from each lateral is allowed to spread over the ground until it reaches the next below it, or rather until all the ground between the laterals which can be overflowed from that point has been thoroughly saturated. Another dam is then put in the lateral at a point below, from which the water can be spread to the ground which has been flooded from the dam above. In spreading the water over the ground attention must be given to it, as dams will have to be

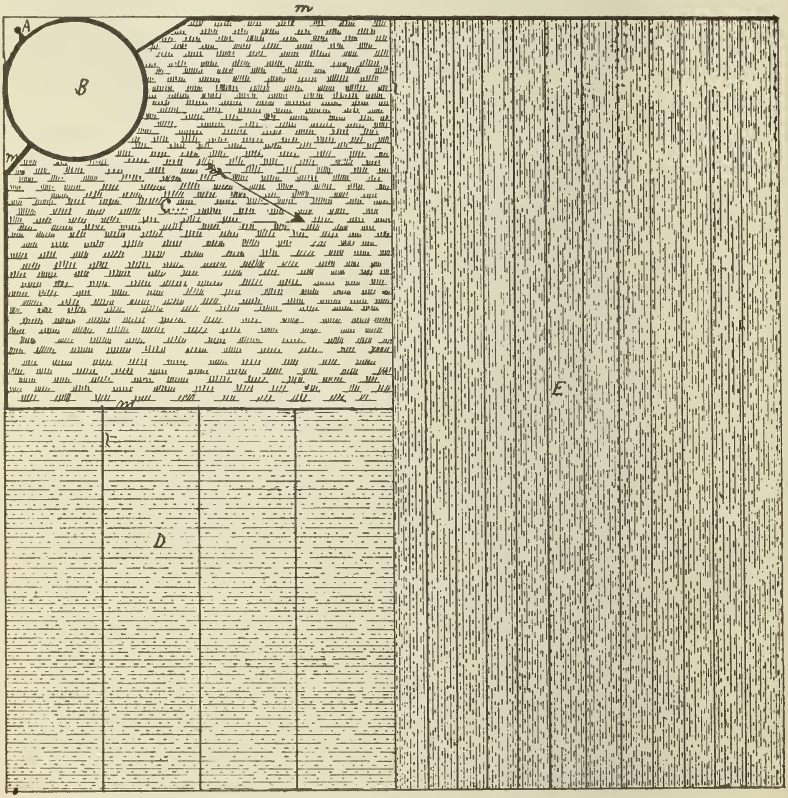


Fig. 1

Fig. 1 illustrates method for the irrigation of sloping land. *A*, well; *B*, reservoir; *m m m*, mains; *l l l*, laterals, *C*, corn field; *D*, meadow; *E*, small grain. The arrow indicates direction of the slope.

thrown in the low places to spread the water over the higher points. When there is too much fall care should be taken to keep the water well spread, as the ground will wash away if too much is allowed to run in one place. These operations are repeated until all the land under this set of laterals is irrigated, the water is then turned into another set of laterals. The benefits derived from laterals are as follows: The duty of water is increased, that is, more land can be irrigated with the same amount, and the water can be distributed more easily and evenly over the ground. One part of the field will not be drowned out while the water is spreading over another part.

THE IRRIGATION OF COMPARATIVELY LEVEL LAND.—Level land cannot be irrigated as cheaply or as easily as sloping or rolling land. Some ideas have been advanced regarding irrigation of level land. One suggestion is to throw up levees round the land high enough so that the water would have to spread over all the points in the field. Another is to build wide ditches or mains through the field raising the water above the level of the ground and carrying it over the fields in laterals. The last plan is the more feasible, as in the first, one part of the crop would be drowned out while the water was spreading over the other. In the latter plan a reservoir is necessary to complete the arrangement, the purpose of the reservoir being to give a volume of water for spreading it over the land rapidly. It will be found in the actual work, that it is very difficult to run water more than twenty rods from the mains. To overcome this difficulty a system of ditches will have to be constructed, running through the field, parallel to one another, at a distance of forty rods apart and twenty rods from the sides of the field. These will be connected with the reservoir which runs along one side of the field, perpendicular to the ditches. Both the main and the ditches should have the banks raised two feet above the level of the ground so the water can be raised a foot and a half above the surface. Laterals are run perpendicular to the ditches every ten rods. These are made by plowing two furrows, thus throwing up a bank on each side of the lateral so the water can be raised a few inches above the sur-

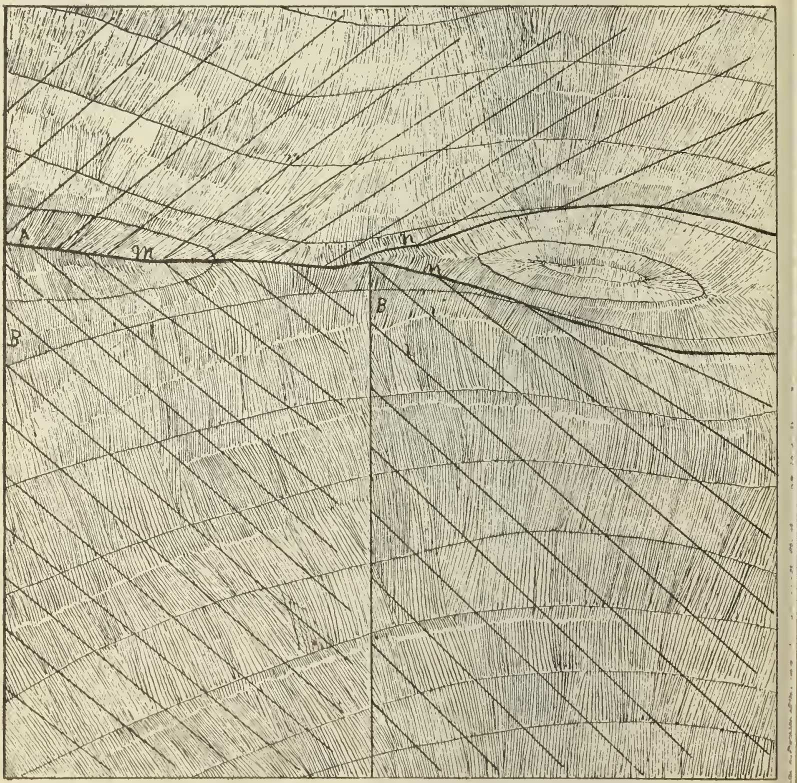


Fig. 2

Fig. 2 illustrates methods of running ditches and laterals into a field with ridge running through it. *A*, well; *m*, main, *n n*, branches of the main running along the sides of the ridge; *B B*, main laterals; *l l*, laterals.

face of the ground. A double mould board plow is recommended for constructing them. These laterals extend from one ditch to the other when place on a strip of land between two ditches. Fig. 3 represents a field irrigated in this manner.

In irrigating from these the water is turned into two of the laterals and these are dammed at the ends furthest from the ditch, or if between two ditches at a point about midway to them. The water is spread on the strip between the two laterals until it meets when it is changed to some point up the lateral or toward the ditch. This is continued until the strip of land between the two laterals is irrigated. In this method a volume of water is necessary to spread it rapidly and evenly over the ground.

When the banks are raised above the level, gates or boxes are necessary for letting the water out of the ditches into the latererals. Gates are also needed at the head of each ditch, and should be so constructed that the flow of water through them can be regulated. These gates may be made in different ways, one of the simplest forms being to nail four boards together in such a manner as to form a small culvert. A gate is then made at one end to turn the water on or off. This is so placed in the bank that the top of the culvert will be on a level with the surface of the water, the earth in the bank being packed round it to keep it from washing out. One of the simplest and one which will answer all ordinary purposes can be made as follows: the box should be of inch boards; four feet long, eighteen inches wide and two feet high. Two-by-fours are put around the ends and the centre for braces. The gate is placed midway between the first and second braces, cleats being nailed on the inside of the box to form a track in which the gate slides. The gate itself may be made in one piece or several; when in one piece, the flow is regulated by raising or lowering the gate, and when in several by taking out and putting in pieces. To secure the gate from washing, what are known as wings are placed at the end of the box on the inside of the ditch. These wings should extend about a foot and a half from the sides. When the box is set it should be made to rest firmly on the ground, trenches being dug for the sleepers underneath. Earth is then firmly

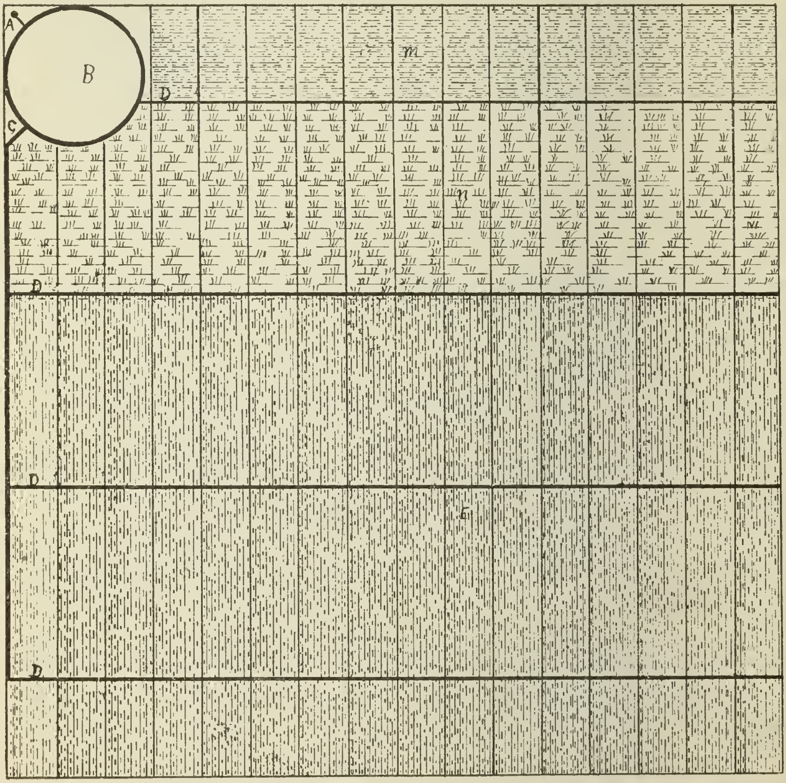


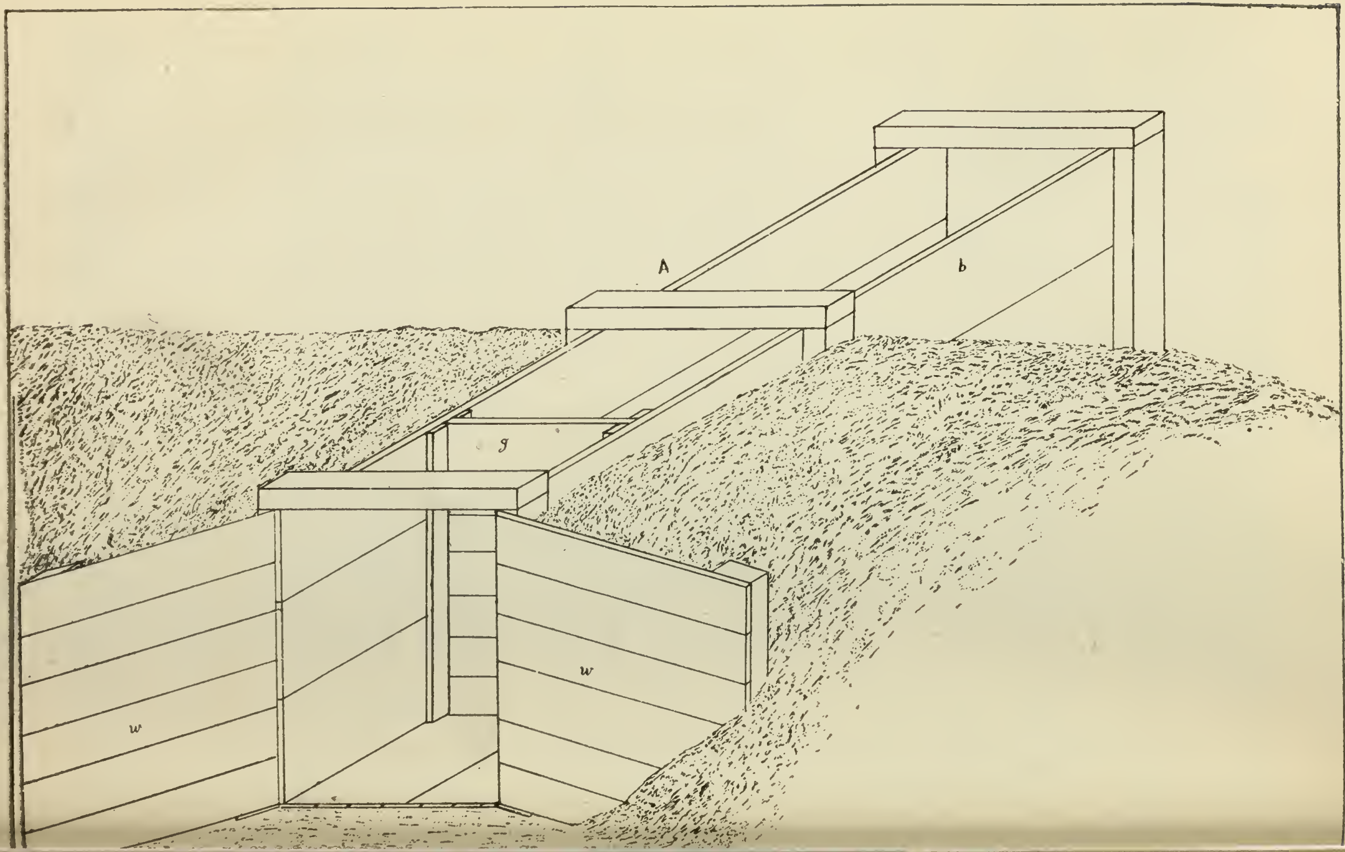
Fig. 3

Fig. 3 shows method for irrigating level land. *A*, well; *B*, reservoir; *C*, main; *D D D D*, ditches; *l l l*, laterals; *m*, millet; *n*, corn field; *E*, small grain.

packed along the sides of the box and the wings. Pieces of boards sharpened at one end, are now driven along the end of the box inside the ditch to keep the water from washing under it. Fig. 4 represents this kind of gate and the method of putting it in the bank.

The gates at the head of the ditches are made in the same manner, the dimensions being two feet and a half wide, two feet high and six feet long. These should have four sets of braces. The gates of the reservoir should be made much stronger. Two-inch planks are generally used in their construction and these are put on the outside of the upright braces. The wings, however, may be made of inch lumber. The box should be at least sixteen feet long, with the wings extending about ten feet from the sides, forming an angle of 115 degrees with them. Another set of short wings should be placed at the lower end of the box. One great trouble with these gates is the liability that holes will wash at the lower end of the box. When the water rushes out it formes an eddy and in flowing round will wash away the banks of the main. To overcome this a wider box is placed at the end of the gate box. This carries the water beyond the point where the eddy is formed and the bottom of the second box keeps it from washing a hole at the end of the gate box.

DAMS OR CHECKS.—When irrigating it is necessary to put dams or checks in the mains to turn the water into the laterals. These are needed especially when the main has considerable fall. They are usually made by throwing a bank of earth across the main. The disadvantage of this is that holes are dug along the edges of the main and the banks are weakened. The best kind of a dam for ditches not over six feet wide is what is known as a canvas dam. This is made by sewing strips of ducking on poles. The ducking should be from four to eight feet long according to the width of the main and from four to six feet wide for a depth of two or three feet. In using these canvas dams two are needed,as they cannot be put into the main when the water is running in it. Before the water is turned in, one of these dams is put in at that point of the main highest in


A
b
g
w
w

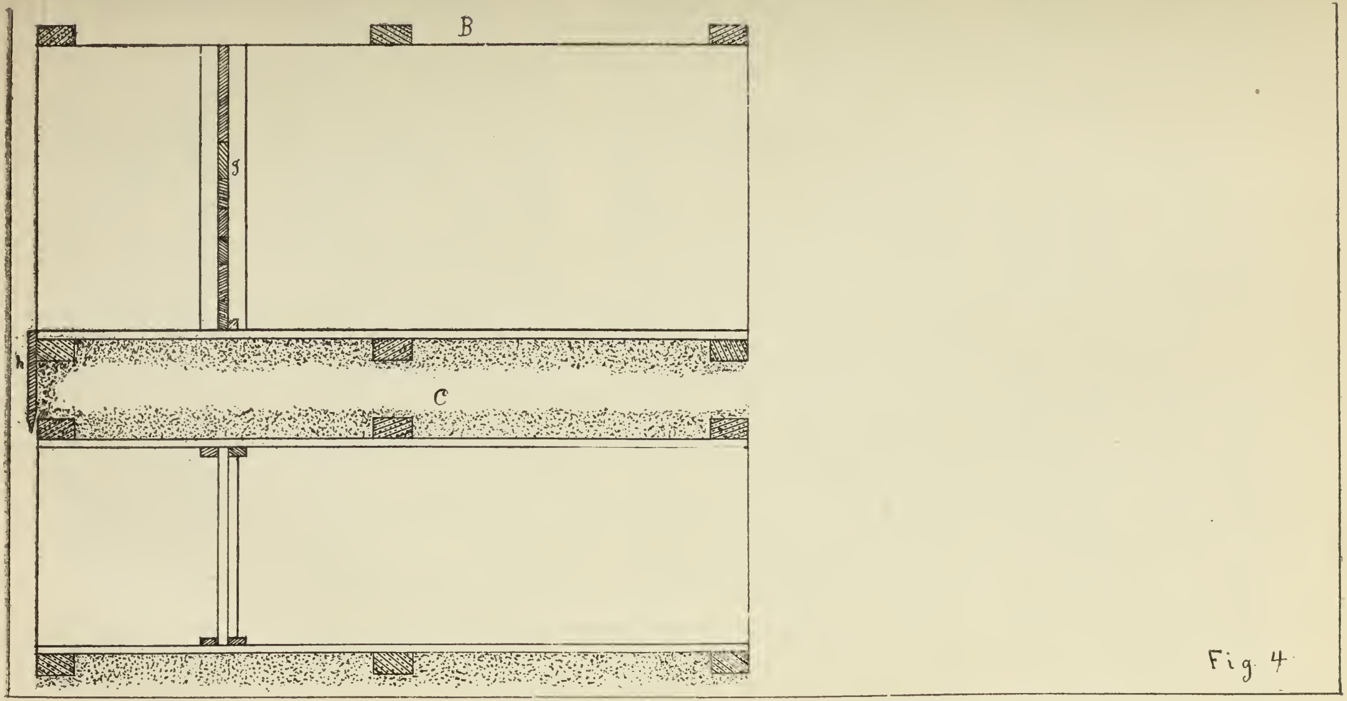


Fig 4

Fig. 4. *A*, gate for letting water from main into laterals. *b*, box. *w w*, wings. *g*, gate. *B*, vertical section of the box. *g*, gate shown as made in pieces. *C*, horizontal section of box. *g*, gate.

the field to be irrigated. When the water is to be changed the second dam is put in at the point next below on the side where the water is to be taken out, the first one is then removed and the operation repeated until the water has been taken out at all the desired points. To put one of these in a main two stakes are driven opposite each other in the banks and the pole to which the ducking is attached is placed across the ditch resting on the upper side of the stakes. The ducking is then spread up stream and enough earth thrown on it to cover the edges and weight it down so the water can not carry it away.

When mains are wide, as is necessary for level land, permanent checks will have to be put in. These should be placed about every forty rods and are constructed something like the gates, for laterals, having wings at both ends of the box. The dimensions should be two and a half feet wide by two feet high and three feet long. In putting these in, a bank is thrown across the main and the box is set the same as a gate in a ditch bank. Fig. 5 will illustrate how these should be put into the main. The checks in the last case are not really necessary if the ditches do not extend through more than one field, but are convenient, in that the whole main will not have to be filled when water is taken out near the head.

Other Forms of Irrigation.—Other methods of applying water to crops are the Mexican system and the Rill system.

The Mexican system consists of throwing up levees around small tracts of land adjoining each other, the levees having gates in them so the water can be drawn from one tract into the next below. In irrigating, the water is allowed to run in the first of these until it reaches a certain depth when the gates are opened and the water drawn off quickly into another tract This operation is repeated until all in the set of tracts have been irrigated.

In the Rill system the water is allowed to run through small channels two feet apart, long enough for it to percolate through the soil. These channels are made by an implement constructed like a corn marker, or by rollers so made that they will form the proper channels. The advantage claimed for this system is that the ground is kept mellow, not baking as it will when flooded. This system can only be used on sloping ground.

WHEN AND HOW MUCH TO IRRIGATE.

When to irrigate and how long the water is to be left on is another problem for beginners to solve. Anyone familiar with crop growing can tell when rain is needed and this is the time to irrigate. When there is a large crop to be irrigated it is not prudent to wait until the crop really needs the irrigation but it should be begun while there is still some moisture in the ground, one advantage of irrigation being that the ground can be kept moist.

Some plants will require more moisture than others and different kinds will also require different treatment in irrigation just the same as in cultivation.

Irrigation of the Cereals.—If there is not, as a general rule, enough moisture precipitated to bring these plants up as soon as sown, it is well to irrigate the ground some time previous to sowing. It is not, however a good plan to sow the grain and then irrigate to bring it up, as the surface of the ground is liable to bake so the growing grain can not get through the crust. If it should be necessary to irrigate the ground for germination, or in fact at any time before the grain is high enough to shade the ground, the Rill system should be used wherever possible. When once the grain is high enough to shade the ground, it grows rapidly until it heads and during this period requires a great deal of moisture, therefore it should be irrigated from one to three times, depending on the soil and amount of rainfall. When more than one irrigation is necessary, the last should take place just previous to shooting as there is danger of rusting the grain if irrigated after this time.

The length of time the water should be left on the ground varies from one to ten hours or until the ground is thoroughly saturated as far down as it has been plowed. If the water is left on the grain for more than 24 hours it is liable to do it some damage. In this respect oats will stand more water than either wheat or barley. When the intention is to irrigate the crop but once, the ground should be plowed in tne fall to a depth of six or eight inches. The grain should be put in early to a depth of two or three inches, a press drill being the best for this purpose. The time to irrigate will always be when the grain needs moisture but if possible wait until it is six inches high.

Fall irrigation can be used to advantage for the cereals. In this state there is usually a dry period lasting through a part of April and sometimes the whole of May. The grain that comes up at this time suffers for the want of moisture, and that which is put in late does not sprout until after the rains, which come, as a rule, in June. What is needed to make good crops, is moisture through this season. This can be supplied by fall and winter irrigation. In much of the fall and winter irrigation, which has been done in this state, too much water has been applied, so that the grain could not be sowed at the right season. Just as much judgment is required for fall and winter irrigation as when a growing crop is being irrigated. The following method for fall irrigation is recommended by Hon. B. S. Lagrange, who was employed by the government to direct the experiments in irrigation at Huron and Aberdeen. Flood in the same manner as for irrigating a crop of cereals. The laterals which have been closed during harvest are opened again and the water is turned on the ground long enough to saturate it as far down as it has been plowed. Just as soon after as the ground is dry enough, it should be plowed. If this can be done in the fall it will insure that the ground will not be too wet in the spring for sowing. Some advocate plowing the ground and then irrigating. Of course these two ways will have to be tested before it can be ascertained which will produce the better crops. Winter irrigation will not do for the cereals as the soil will be too wet in the spring to get the crops sown in the right season. It may do for flax and other crops which can be sown late

IRRIGATION OF FLAX.—The ground on which flax is sown should contain considerable moisture in order to insure its coming up and on this account the ground is best irrigated during the previous fall or winter. While growing it should receive water once or twice. If the ground has been well irrigated before sowing, once will be sufficient. Flax will be greatly damaged if the water is allowed to remain on it for twenty-four hours.

MILLET.—This being a rapid grower, requires a great deal of moisture after it comes up. It may be irrigated at any time, but like the cereals water must not remain on it long. If it is grown for seed it is best not to irrigate after it heads.

CORN.—In irrigation of corn another method is used known as irrigating between the rows. In this method the water is run in the furrows made by the cultivator, not allowing it to touch the hills. In this way the soil is not packed and baked round the roots but is kept loose and mellow. Corn does not require as much moisture in the ground when it is growing, as wheat or millet, and it is seldom necessary to irrigate it until the tassels begin to appear, then a good head of water is turned on, and run through the rows as rapidly as possible. When it has run entirely through one set of rows it is turned into another, leaving a small stream running in each of the rows through which it has passed long enough to percolate through the soil to the roots. In Colorado, corn is grown without irrigation on ground which was irrigated the previous summer but the best crops are obtained when the water can be turned on at the time of tasseling. As there is generally enough rain in South Dakota to keep the corn growing in the fore part of summer it is not best to irrigate until the tassels begins to appear.

POTATOES.—Potatoes, as a rule, should not be irrigated until the sets appear, but like everything else, if suffering for water before this time, it will be necessary to irrigate them. They should first be cultivated, the shovels of the cultivator being set so the dirt will be thrown toward the rows, thus ridging them up. The water is then turned on and the irrigation is done in the same manner as described for corn. After once being irrigated care must be taken not to let the ground get dry as that is liable to scar the potatoes, and on the other hand, if kept too wet the growth will all be in the vines. After the first irrigation the potatoes should be cultivated again as soon as possible in order to keep the soil loose and mellow. In no case should they be flooded as it is sure to damage them if it does not entirely destroy the crop. For this reason it is difficult to irrigate potatoes on level land.

SUGAR BEETS.—Sugar beets are at present attracting a great deal of attention in this state. The only method of irrigating them with which the Irrigator is familiar is by flooding. This however, compacts the soil too much, as to obtain the best results the ground should be kept as mellow as possible. The only way to overcome this crustiness is to make a small trench between the rows and run the water through these until the soil around the beets is saturated. Sugar beets should be irrigated only during the early part of the season as too much moisture in the latter part will lower the percentage of sugar.

THE IRRIGATION OF THE GARDEN.—Nearly all garden vegetables can be irrigated by running the water between the rows and allowing it to seep through the soil around the roots When it is necessary to flood garden vegetables the ground should be hoed as soon thereafter as it is dry enough, to prevent surface baking. When there is not enough moisture to bring the seed up the ground should be irrigated before planting. Garden plants generally require a great deal of moisture to give the very best results. Cabbage, as a rule, will do well without much moisture, while cauliflower and celery will flourish if water is kept running between the rows, but celery will not have as fine a flavor if treated in this manner as if less moisture is applied. It should be irrigated about once each week until ready for blanching. Tomatoes do not need much water after reaching a certain stage of growth unless the soil is sandy, as all the growth will go to the vines, and such vines will not bear well and the tomatoes on them will not ripen. In setting

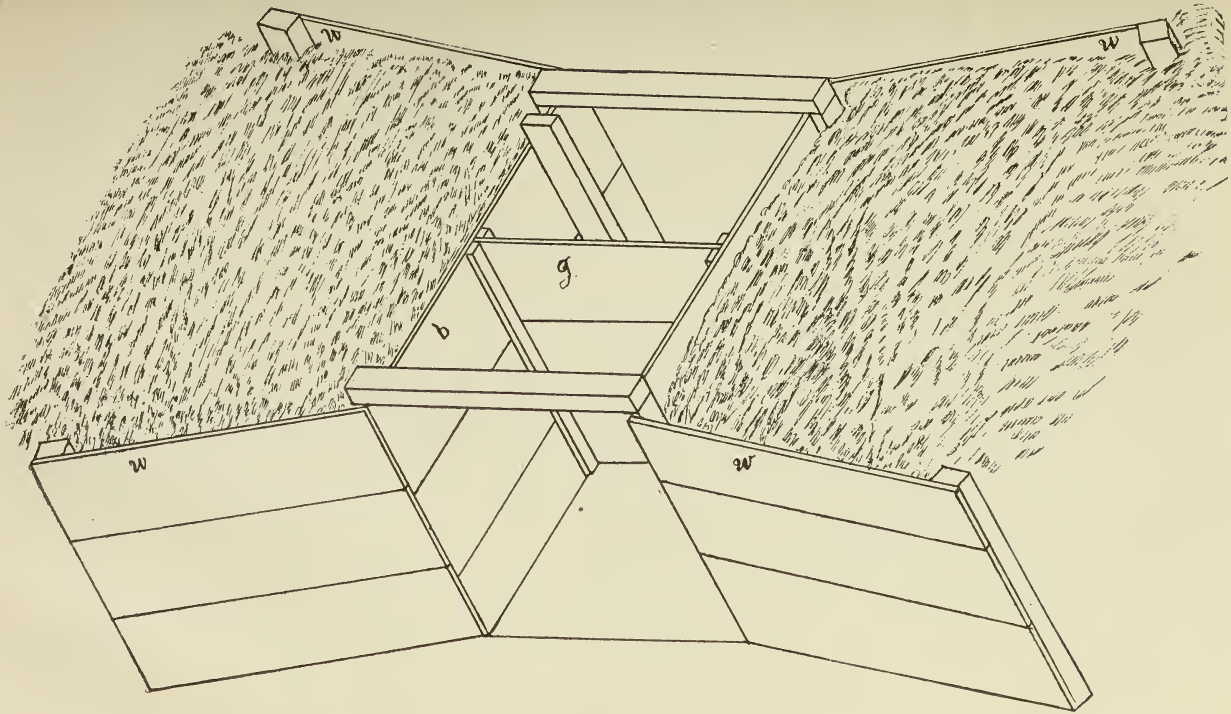


Fig. 5. Check for wide main. *b*, box; *w*, *w*, *w*, *w*, wings; *g*, gate shown as made in one piece.

out tomatoes, and in fact all garden plants, the ground should be marked out, making a small trench in which to run the water. The plants are set in these trenches and the water is turned on as soon as they are set. After irrigation dry earth should be hoed around the plants to keep the soil from baking. Another method is to irrigate the ground first, setting out the plants as soon as the ground is dry enough to work.

STRAWBERRIES AND OTHER SMALL FRUITS.—These require more water when first set out than after the roots are well developed, and the ground should be irrigated immediately after the setting. Irrigated strawberries are generally grown in matted rows or in hills. When preparing a strawberry bed, the marking is done by plowing a furrow for each row; this furrow is levelled over to the next and the plants are set along the edge at a point where the running water will just come up to them. When strawberries are grown in beds, the usual method of irrigation is by flooding, but they are better grown in matted rows, as the plants can be irrigated during the bearing season without damage to the fruit. Strawberries and other small fruits should be irrigated once every two weeks.

TREES.—Trees require more moisture the first season after planting than when the roots have become well developed. As soon as set out the ground should be irrigated, and for the first season water should be applied at least once every two weeks during the growing time; after this, four or five irrigations during the spring and summer will be sufficient. Trees are generally supplied by running water between the rows, but this is not necessary as ornamental trees on lawns are irrigated by flooding. The water should be allowed to remain on the ground long enough to penetrate to the lowest roots, but judgment must be used with regard to different kinds of trees. Some will flourish with an amount of moisture which would destroy others. The cottonwood and the willows will grow and flourish if water is kept around their roots during the entire growing season, while the apple and most of the other fruit trees would perish under this treatment. As a rule all trees will do well if irrigated once each month of the growing season. It is not best to irrigate late in the summer for some species, as time must be given for the wood to ripen.

MEADOW LAND.—Native meadow lands require most moisture during the spring and consequently should, if possible, be irrigated during winter and in the early spring The irrigation of other meadows depends on the kind of grass but as a rule, water should be supplied in the spring. Timothy, in particular, needs a great deal of early moisture to make a good crop. Where more than one crop is produced during the season, the meadows are irrigated as soon as the hay is taken off. For alfalfa, the best results are obtained if it is irrigated about the middle of May for the first time, the second and third irrigations following the taking off of the first and second crops. It can be grown with only one irrigation during the season, but it will not be as good in yield or quality. Clover, to do its best, requires a great deal of moisture and during the first season should be irrigated several times. For both clover and alfalfa it is not best to irrigate during the fall and winter, as the action of the frost on the wet ground causes the plants to winter kill. Orchard grass may be treated the same as alfalfa, irrigation taking place just as soon as the crop is taken off the ground. All meadow lands should be thoroughly saturated, the water remaining on the ground from 6 to 24 hours. The danger of damage through leaving the water on them is not so great as in other crops but unreasonable length of submergment may cause great damage. The irrigation of meadow land requires just as much judgment to secure the best results as that of other crops.

In all irrigation a great deal depends on the surrounding conditions, as the amount of rainfall at the time or the moisture in the soil. The methods given are, with a few exceptions, those used in Colorado and the same rules, with some slight changes in the details, can be applied in this state.

EFFECT OF IRRIGATION ON RAINFALL.—Will the filling of natural reservoirs and channels increase the rainfall enough to insure sufficient moisture for raising crops? It is believed by many that it will, because good crops were raised during the period when all the lake beds contained water. The cause of this rainfall can no more be attributed to the lakes, than can the lakes to the excessive rain and snowfall of this period. This moisture when it filled the lake beds, saturated the ground at the same time, and was stored in the lower depths and was used by the crops which followed. During the last ten years, hundreds of lake beds have been filled in Colorado as reservoirs and by seepage water but no increase of rainfall is yet noticed, and in Utah agriculture depends on irrigation, even to the shores of the great Salt Lake. On this question, nothing but opinions, with reasons for the same, can be given. The following theory has been advanced to account for these seasons of sufficient moisture. A part of the Dakotas is in what is known as the semi-arid region, and over this belt, the line of sufficient moisture to produce crops, vibrates back and forth.

EXPERIMENTS IN IRRIGATION.

The decision of the Board of Trustees of the South Dakota Agricultural College to conduct experiments in irrigation was not reached until so late in the spring that operations could not begin before the 20th of April.

As everything had to be done after this date, the small grain was not sowed until too late to obtain the best results. As the experiments were for the purpose of showing methods of distributing the water over the crops, as well as its effects upon them, Stations were selected at the following places: Mellette, Frankfort and Huron.

Mellette being the chief Station, work was begun there as soon as possible after the arrival of the Irrigator. The experimental grounds at this place contained twenty-six acres, being in a strip 29 rods wide. A main was run from a well down through the center of this strip; laterals were run perpendicular to the main about every ten rods, making the dividing lines for the plats.

WHEAT.—On the 21st and 22nd days of April the ground was plowed to a depth of five inches. It was in good condition for sowing and the grain was put in with a press drill on the 22nd of April. It came up and grew well until the 20th of May when it began to need moisture. The main not being completed at this time the grain was not irrigated and the rain of May 30th made it unnecessary until the 12th of June when it again need moisture. The plats containing the different varieties of wheat were irrigated as follows: Blount's Hybrid, No. 17, June 13th; Kubauka and Velvet Chaff, June 15th Saskatchewan, June 22nd; the latter was not irrigated at the right time on account of an accident to the main, consequently many of its stools were killed by the drouth. The straw of all these varieties averaged over four feet in height and their average yield was 25 bushels to the acre by machine measure. The Saskatchewan yielded over 27 bushels to the acre, and, had it been irrigated in time, it probably would have given over thirty. The average yield of wheat in the surrounding fields did not go over ten bushels to the acre and that which was sown about the same date yielded not more than six bushels to the acre. The wheat in this experiment not only had the disadvantage of being sown late, but was also put in on spring plowing which alone would tend to lower the yield. It did not receive any more care than is usually given to irrigated grain, and on account of scarcity of laborers the main was not completed until it had suffered from lack of moisture. After the water was turned in the main, the work was delayed by its banks giving way.

Barley.—The ground was plowed on the 27th and 28th of April and the grain was put in on the 19th with a press drill. The condition of the ground was not favorable for germination, as the wind rapidly dried the moisture out of the plowing. Part of the seed did not come up till after the rains, beginning May 30th. The barley was not irrigated until the 30th of June. The straw of the Danish and Manshury barley averaged three feet and that of the White and Black Hulless two feet and a half in length. The average yield of the two former was over 28 bushels to the acre and that of the Hulless varieties a little over 20 bushels. Here, as with the wheat, the deferred irrigation, on account of trouble with the banks of the main, lowered the yield but it was still much better than the unirrigated barley in the same vicinity.

Oats.—The oats were sown on the same date and under the same conditions. Part of the seed did not come up until after the rain and one plat was nearly drowned out on account of the banks of the main giving way. Two plats were irrigated on the 29th and 30th of June; one being the White Belgian and the other the Black Prolific. The average length of the straw of the first was four and a half feet and the second five feet. The yield of the White Belgian was forty-five bushels to the acre, but the Black Prolific, being a late variety, was badly rusted by a rain which came about the first of August. This damaged the crop so much that it was nearly worthless.

MILLET.—This was sown on the first day of May. The ground being dry it did not come up well and what did come up at first was killed by the late frost. After the rains in June it came up, but was not thick enough to make a good crop. It was irrigated on the 8th and 9th of July. It made a rapid growth after irrigation and the yield was about two tons and a half per acre. Some millet was sown on the 10th of June for a late crop. This made good hay, but was too late for seed as the early frosts caught it. It was irrigated at the same time as the earlier piece. The yield of hay per acre was about three times the amount of that which was not irrigated.

CORN.—The seed was not planted until the 10th of May and did not come up until the last of the month. It was irrigated the 25th of July, just as the tassels began to appear. It eared well and was not affected by the hot winds of the fore part of August. No results were obtained as it was killed by the early frost which came on the 23rd day of this month.

POTATOES.—The potatoes were planted April 30th. The plants did not appear until the last of May and then not more then half the seed came. They were irrigated but once during the summer. The yield was good, although the frost killed the vines before all the tubers had become fully grown, which somewhat reduced it. The ground on which the potatoes planted were was very difficult to irrigate properly and the crop was damaged by the water overflowing the vines.

SUGAR BEETS.—These were not planted until May 21st, and came up immediately after the rain of May 31st. The beets were irrigated three times during the months of June and July, the method used was flooding, but this packed the ground about them so that it was necessary to hoe them after the first two irrigations. The yield per acre would have been more and the beets would have been of a better quality, had the irrigating been done by the rill system or running the water between the rows. The yield of the irrigated beets was better than those on the same plat not irrigated and the chemical analysis shows an equal per cent sugar.

THE GARDEN.

The garden vegetables that were planted grew splendidly and were kept green and fresh during the long period in which but little rain fell.

Tomatoes.—These were set out on the 28th day of May. The ground was marked with a plow and the plants set in the edge of the furrow, water being let in as soon as they were put out. Although the next day was very warm and dry, but few of the plants died. The soil was kept almost too wet for the best results, as the vines grew very rank without maturing many tomatoes.

Early Cabbage.—These were planted at the same time and in the same manner as the tomatoes and received the same treatment. They grew well and the heads were solid and ready for use the first of August. Cabbage grown in the same neighborhood but not irrigated was, as a rule, a failure. Late cabbage was also grown successfully, and cauliflower, which naturally requires more moisture than ordinary plants, did well.

Celery.—The plants were set out on June 20th on ground which had been irrigated. They were small and but half of them survived the hot days which followed. The remainder was kept moist and the crop was extra good.

Trees.—Three varieties of trees, Willow, Poplar, and Ash, all of one year's growth, were planted at this place. These were irrigated soon after setting out, and several times during the summer and only three per cent. died, most of them making a good growth.

Some apple grafts were planted at the same time, nearly all of which survived and grew well; the loss being only about ten per cent. All these trees were planted the 8th of May when the ground was very dry and doubtless would not have survived the rainless period which followed, without irrigation.

EXPERIMENTS AT FRANKFORT.

Mr. H. S. Riggs, by request, sends the following report of the work done at Frankfort:

The following is a synopsis of tests made in farming by means of irrigation: While the results may not be as great as might be expected, yet, considering the circumstances under which these tests were made, they are entirely satisfactory. The artesian well at Frankfort, in fault of construction has, since it first commenced flowing, thrown muddy water, in fact, there is so much sediment that in a week's time it fills the main ditch to the top with mud. The main is constructed above ground and is 10 feet wide and 4 feet deep, The water must be carried a half mile before it reaches the land to be irrigated, which lies 30 inches above the level of the land at the well. It will be seen that the cleaning of this amount of sand out of the ditch was no small item in time and expense. The main was cleaned through a number of sluice gates. By opening them, the sand is washed out by force of the current. At times when water was needed the most, we had to stop and sluice out the ditch.

Some Results.—Sept. 20, 1890, winter wheat was sown in corn ground. The land was too dry to germinate the seed and had to be irrigated to bring it up. It made a poor fall growth and went into winter rather puny, was all alive in the spring, irrigated May 1st, made a fine growth and was harvested July 1st. The yield was 30 bushels of fine plump wheat of Fultz' variety. A plot of winter rye sown, irrigated, harvested and threshed at same time as the wheat, gave a yield of twenty bushels. A field of fifteen acres was soaked during the winter and was so wet in the spring we could not get on the land to seed until May 20. The soil seemed cold and clammy and the wheat did not get started during the good growing weather when the other crops were making fine growths. It did not make much growth until the weather was too hot for best results with wheat. The hot sun caused it to rust but after irrigation the rust left. The crop was harvested and threshed and made an average of eighteen bushels. Some spots that were above water did not grow 6 inches high and did not produce a kernel. A field that had been in millet and irrigated last year was sown to wheat May 12, came up and made a fine growth, was irrigated the last of June and yielded twenty-two and one-fourth bushels. Hulless barley that was sown June 1st made a yield of thirty bushels machine measure and weighed 61 lbs Spots in the field that did not get any water grew about as high as buffalo grass. A plot sown to flax June 15th on land that had been in sod for ten years, and was almost the same as wild sod, land was irrigated once and yielded sixteen bushels. I may add that this land had been covered with water all of last winter I believe, under favorable circumstances, wild sod land, well soaked and sown in good season, will give a yield of twenty bushels. Last year, on old land, flax sown about the same date as above made twenty-one bushels; millet, four tons per acre; corn, forty-five bushels, etc.

It will be seen that the times of sowing the above crops were all out of proper season. Planted at such late dates it would have been almost imposaible to grow any crop without irrigation.

While I am convinced that irrigation is going to be a grand success in grain farming, it is equally important in stock growing, mixed farming, and the raising of many kinds of fruits.

The most satisfactory test made was with Kentucky Blue Grass. I have never seen such a growth of tame grass, not even in the native home of the Blue Grass. I don't think I overdraw it, when I say that one acre well set in Blue Grass and well irrigated, will yield more pasture than twenty acres of native grass without irrigation. This will hold true of the wild grasses. In both cases it will take two years to get the best result as a good bottom has to be made.

The success in irrigation so far as tried in Dakota may not be up to the expectation of the public, yet, the fact should not be forgotten that we have it all to learn and the methods of other countries may not be the best for Dakota. The system of irrigation in California and Colorado has undergone many changes and those states have made more advancement and learned more of the science in the past two years than in all of the thirty years before. I am convinced that winter soaking of the land is not the best method, but think the best time to flow the land for the next crop is as soon after harvest as it can be done. Then after wetting the land thoroughly, as it dries enough, plow and fit for the next crop. By this method the land will have plenty of moisture to start the crop in good shape and then one good irrigation about the time wheat and other grain is in bloom which will insure a good crop.

Economic Distribution.—After much study on methods, I have come to the conclusion that with water from artesian wells the only economic use is by means of a suitable reservoir to collect the water, and instead of using it direct from the well, draw it direct from the reservoir. A larger amount of water can be used at a time, thus getting over the same land in less time and with the saving of a great amount of water. It is thought that from 6 to 10 inches of water will be abundant with our natural rainfall, but without areservoir the trouble is to get that amount on the land without getting much more. A well flowing 1,200 to 1,300 gallons, the water used as it flows, will put more than two feet of water on the ground before it can be spread. Now, if three to five times this amount of water could be used as cheaply, a much greater amount of land would be watered with less water and in a shorter time, which would be a great saving and of special advantage when all crops are needing the water at the same time. Land watered quickly would not be baked but it would have the same effect as from a good heavy rain. It may be claimed that rushing a large amount of water over a crop would injure it, but I have had the water on wheat, barley and oats a foot deep while distributing it over other portions of the field and my experience is that where the water was deepest the crop was best.

HURON EXPERIMENT.

The work here was under the local management of Mr. A. W. Wilmarth.

The only land obtainable that could be conveniently irrigated from an artesian well was not a desirable piece on account of its contour and occasional "gumbo" spots. It had been flooded during the winter and was consequently too cold and wet for seeding until very much too late for good results. A heavy rainfall immediately followed the first irrigation and made the amount of moisture on the whole piece excessive, overflowing and completely drowning out the grain on the lower portions. Considering these disadvantages, the general results were quite satisfactory.

The experiment added proof to what was shown at Frankfort, that winter irrigation is not the most advantageous for grain raising, especially for those kinds that require early seeding

CONCLUSION.

In these experiments there was not a single case which showed in any way that the water was injurious to the plants, the only damage done resulted from allowing it to remain on the ground too long. The water contains salts of lime, magnesia, potash and soda which may be termed fertilizers. It also contains considerable ammonia which is a solvent and puts much of the material used by plants in a condition to be absorbed by them.

If anything is needed in the artesian water it is animal and vegetable organism. This, however, may be obtained by storing the water in reservoirs.

The water is not cold enough when applied directly to the growing plant to check or in any way interfere with the growth. In Colorado if the water which comes from the melting snows in the mountains be appliad to corn during the fore part of the summer its effect will be seen during the remainder of the growing season as the corn will have a sickly appearance. This is due to the chilling effect of the water upon the growing plant. The cereals are checked in growth for a day or so from the effects of the cold water but soon recover and begin to grow with all the more rapidity and vigor.

There is much reason for believing that if the ground be irrigated in the fall and early winter, so that the seed can be planted in time, a good crop of the cereals may be produced without any further application than the annual rainfall.

With the aid of irrigation trees can be grown, and, when these are scattered plentifully over the plains, it will no donbt have a decided effect on the hot winds which prevail here at times during the summer. If the effects of these winds can be neutralized in any part of the state, it will be a great benefit to its agricultural interests. All of the experiments go to show that irrigation by means of artesian wells is a success in South Dakota and there seems to be no reason why the James River Valley, once famous for its fertility and productiveness, will not become one of the most prosperous agricultural sections in the United States. It has all that is necessary, the fertile soil and the water which may be obtained in abundance from artesian wells. All cannot be obtained at once, as time and experience will be necessary to reach the highest state of perfection.

SOUTH DAKOTA

AGIRCULTURAL COLLEGE

AND

EXPERIMENT STATION

BROOKINGS, S. D.

BULLETIN NO. 29.

DECEMBER, 1891.

Department of Forestry, Horticulture and Botany.

FORESTRY AND FUNGI.

DUTCHER & BREED, BROOKINGS,

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The Bulletins of this Station will be sent free to all residents of the State who will apply for them.

Mail for the Station should be addressed to the Director, and that for any special department to the officer in charge.

FORESTRY.

C. A. Keffer, Superintendent.

The season of 1891 has been favorable for forest tree growth at the Experiment Station. The oldest planted plats begin to assume something of the nature of trees, and to illustrate characteristics of growth in the different species that seem to indicate their ultimate utility in this region. Observations have been made during the year upon the rate of growth of the different species, more especially with a view to determining what trees will quickest form leaf canopy and thus require least cultivation. This is a matter of supreme importance to the farmer tree planter. Unlike the nurseryman, or the forester, the farmer's tree planting must, in the nature of his vocation, be one of many operations; and it is usually the last to receive attention. In a very excellent bulletin recently issued from the Forestry Division of the Department of Agriculture on "What is Forestry?" Chief of Division Fernow proposes as an experiment, "to simply break the sod in June, and sow millet or oats thickly to make a close stand; this will secure a return for the labor of breaking. The millet should be cut with a high stubble, which may be expected to catch the winter snow, keep down weed-growth, and act as a mulching the next season. Plant next spring as early as possible, in trenches, without disturbing the ground between trenches, and most likely cultivation will not be necessary the first season, while the second season, with our dense planting, the trees should be able to help themselves." This method is suggested more for the Sand Hill region of Nebraska than for localities having a stiff clay subsoil. It is certainly very different from our ordinary practices, and if successful generally should act as a great impetus to tree planting, as it reduces the work to a minimum. The reason why it is introduced here, is not to recommend it, but only to indicate a fundamental principle in forest planting: the necessity of securing a shade for the ground at the earliest possible moment. So far as the method suggested by Prof. Fernow is concerned, it would seem impracticable in this state, where the grasses quickly take uncultivated ground, and where the ordinary rainfall is not sufficient to insure the vigorous growth trees would have to make to overcome the grasses and weeds. However, it is an experiment easily tried, and planters would get some interesting experience by devoting a small plat to the work.

METEOROLOGY AND GROWTH.

METEOROLOGICAL TABLE.

Month.	Rainfall.			Temperature.			Wind.	
	No. Days	Greatest in one day	Total	Highest	Lowest	Mean	Northerly	Southerly
1889.								
January	......	......	.3	41. °	-24. °	15. °	....	....
February	......	......	.5	43. °	-30. °	19.6 °	11	....
March	......	......	.16	55. °	4. °	32. °	17	6
April	11	.27	1.025	83. °	12. °	51.20	10	15
May	9	.62	1.93	91. °	20. °	56.7 °	15	8
June	11	.54	1.485	93.6 °	36.1 °	64.2 °	15	14
July	9	.89	2.918	96. °	40. °	68.8 °	11	16
August	3	.53	.72	97. °	41.8 °	69.5 °	6	15
September	4	2.22	2.70	89. °	30. °	55.1 °	9	10
October	1	.005	.005	76.4 °	23.8 °	43.7 °	18	10
November	......	......	......	28. °	-6. °	22.87	15	11
December	5	.475	.975	52. °	-11. °	26.78	13	18
1890.								
January	5	*2.	*6.5	43.9 °	-28. °	7.56	15	16
February	1	*2.	*2.	47. °	-35 °	14.32	15	13
March	3	.31	.56	32.25	-4. °	19.69	13	14
April	4	.51	.787	84. °	10. °	46.71	10	12
May	12	.80	3.33	90. °	23. °	32.197	20	9
June	14	2.	7.91	90.5 °	39. °	67.75	6	22
July	5	.54	1.535	94.5 °	41. °	71.06	10	19
August	5	.88	2.07	99. °	35. °	63.8 °	14	16
September	5	.19	.45	91. °	25. °	57.5 °	11	16
October	7	.12	.32	74.5 °	21. °	38.8 °	6	11
November	1	......	.03	68. °	0	29.41	22	12
December	......	......	......	53. °	-18.	21.2 °	8	19
1891.								
January	......	......	......	52. °	-10. °	+	14	16
February	*3	*4.	*10.	48. °	-28.	6.95	11	17
March	*2	*4.	*6.	50.	-24.	17.94	13	15
April	9	.93	2.23	88.	11.	43.9	18	9
May	5	.38	.84	92.5	30.	55.54	17	12
June	11	1.34	4.09	89.	40.	62.5	15	14
July	7	.7	2.01	80.	60.	69.5	13	16
August—Frost on 23rd	7	.44	1.38	99.5	30.5	66.3	15	14
September	5	.27	.48	98.	23.5	65.1	24	6
October	2	.62	1.07	80.	19.5	45.4	15	11
November	......	......	......	......	......	......	....	....
December	......	......	......	......	......	......	1	2

* Snow. + Observations not complete.

Total rain fall during growing season.—

April to November inclusive—	1889, 10.783	inches.
" " "	1890, 16.402	"
" " "	1891, 12.10	"

In the spring of 1891 eight half-acre plats were added to the forest plantation, making a total of thirty plats or fifteen acres, planted since 1889. Planting began April 23rd and was completed within two weeks. Copious rains fell April 13 and 16, with light showers on the four following days, and .26 inch rain on the 27th. These showers made the ground in good condition for planting, and in those plats that were set while the soil was moist a good stand was secured. Before the two last plats were set the weather had turned dryer, and, as during the entire month of May only .8 of an inch of rain fell, the stand in these plats is poor, the more so as a large proportion of the trees set in them were pines and spruces. All the trees that were planted early enough to be benefited by the April rains made good growth during the season, the months of June and July being especially favorable for growth. After July 21st only 2.63 inches rain fell the balance of the season, as against 2.87 inches for the same period in 1890. The extreme dry autumn of 1890, with the lack of snow in the winter, resulted in quite severe winter killing, the box-elders being most injured. The rainfall was a little better distributed this year, and it is hoped less injury will result.

The year's planting showed the great importance of having the ground in suitable condition as regards moisture when planting is begun. Had planting been begun a week earlier last spring a better stand would have been secured, as the trees would have thrown out young roots before the dry weather of May came. By having the land deep plowed in the fall, the planter will be able to take advantage of the first favorable spring weather to begin operations.

Following is a plat of the forest plantation, showing the varieties in each plat, and the number of trees alive in each in November, '91. As the blanks in several plats were filled in last spring and trees thus set were not included in the summaries of plats 1 to 10 made in another place in this bulletin, the totals in the diagram and in the summaries will not agree.

In order that the numbers of the plats may follow in order as the plantation is enlarged, a change in the numbering is made from that which appeared in Bulletin No. 20. Plats 1 to 10 were planted in the spring of 1886, plats 11 to 22 in 1890, and plats 23 to 30 in 1891.

SOUTH.

ROAD.—1 rod wide.

8 Rods.

10 Rods,

17A	16	14	12	10	8	6	4	2
Populous certinensis	Silver Maple.	Green Ash	Box Elder	Black Cherry Yellow Birch White Birch White Elm White Ash	Soft Maple Cottonwood Scotch Pine White Ash White Birch	Populus certinensis White Elm White Ash	Box Elder Yellow Birch White Pine	Pop. (4 var.) Bla'k Walnut White " " Birch " Elm " Ash Box Elders
1346*	1160	1195	1100	1247	1018	1309	1039	805

ROAD.

17B	15	13	11	9	7	5	3	1
Populus certinensis	White Elm	Green Ash Seed	Box Elder Seed	Bl'ck Walnut Cherry Box Elder Wh't Walnut P. certinensis White Elm S'lix fragilis White Birch White Ash White Pine	Box Elder White Ash Bl'ck Walnut Black Wild Cherry White Elm Populus 2 varieties	White Elm Box Elder White Oak Bl'ck Walnut	European Larch Box Elder	Black Hills Spruce Box Elder Cottonwood Populus certinensis Scotch Pine
	1301	1182	1153	959	1113	1102	737	1035

ROAD.

26A	25	24	23	22	21	20	19	18
Maple Box Elder Walnut Hickory Elm Ash Cherry	Box Elder Maple Walnut Cherry Elm Ash	Box Elder White Spruce	Box Elder Cherry Ash	Populus certinensis	Green Ash	White Elm	Populus certinensis Soft Maple	Silver Maple Hickory
943*	1138	954	1008	1368	1165	1258	1062	1245

NOTE.—The blanks in plats 1 to 10 were filled in in the spring of '91, and unless especial mention is made in the notes on these plats, the trees thus planted are not included in the totals of the table.

ROAD.

26B	27	28	29	30
Maple Box Elder Walnut Hickory Elm Ash Cherry	Maple Box Elder Elm Ash Cherry Bl'ck Walnut Butternut	Box Elder Elm Cherry Butternut Hickory P. certinensis	Elm Ash Cherry Spruce Hickory Butternut Box Elder	Elm Ash Cherry Spruce
	1151	1163	997	557

ROAD.

* No. trees in 17A and B, and 26A and B. † No. trees in plat.

THE MIXED FOREST PLATS.

The following notes on the ten oldest forest plats, which were planted with one and two year seedlings in the spring of 1889, are given as showing the present condition of the various mixtures, and their utility in shading the ground. The plats are numbered as indicated in the diagram published.

PLAT NO. 1.

This plat, as will be seen by the diagram, has for its temporary trees (those that are to be taken out first as thinning becomes necessary) box elder and *Populus certinensis*, and for its permanent trees green ash, white spruce from Black Hills and Scotch pine. The spruce were used, not because they were regarded as especially suitable for permanents, but because, having but few specimens, it was thought they would have a better chance in this arrangement to show how well they would withstand exposure. The following diagram shows the position of the trees, which are four feet apart both ways.

NORTH.

B	S	B	A	B	S	B	A
B	P	B	P	B	P	B	P
B	A	B	S	B	A	B	S
B	P	B	P	B	P	B	P
B	S	B	A	B	S	B	A
B	P	B	P	B	P	B	P
B	A	B	S	B	A	B	S

SOUTH.

B—Box Elder.
S—White Spruce.
P—Populus certinensis,
A—Green Ash.
Scotch Pine substituted in part for White Spruce.

At the time of setting, in the spring of 1888, the box elders used were one year seedlings, shipped in from nursery; the ash were two years old, having been grown in our nursery one year; the poplars were one year old, from cuttings set the previous spring: the spruce were from ten to twelve inches high, seedlings brought from the woods in the Black Hills. In a few rows Scotch pine, twice transplanted, were used in place of spruce. In a few cases cottonwood was substituted for poplar. A very poor stand of box elder was secured, the yearling trees not growing near so well as the two-year-olds set in other plats. In '90 the blanks in box elder rows were reset with yearling box elders. Last spring all blanks were set with yearling ash, the average growth of which for the season has been about two inches.

The plat is, with one exception, the most open in the plantation, it being easy to pass among the trees without touching the branches. The box elders will not average more than four feet high, though those of the original planting are seven feet high. The poplars average about seven feet high, and only one of the original setting has died. This poplar (*P. certinensis*) is erect in habit, though not quite as upright as Lombardy. The ash averages about four feet, only seven of the original setting being higher than six feet. The spruces have merely become established, somewhat more than half are promising, the rest being in bad condition.

The forest plats were cultivated twice the past season, the last time in June. As certinensis poplar is not a dense shading tree, and the remaining species have not made good growth until this year, the weed growth has been as great in this plat as in any other save the larch plat. No math of weeds has formed, and the land is now what would be called clean by many farmers. The weeds that have grown among the trees of this plat are *Agrostis major*, *Pancum capillare*, and *Setaria viridis*, grasses; *Chenopodium album*, lamb quarters; *Amarantus albus*, tumble weed; *Portulaca oleracea*, purslane or parsley; *Rosa blanda*, wild rose; of these the fox tail grass (*Setana viridis*) and purslane are most prevalent. In an adjoining plat in which the shade was dense throughout the summer, soil and other conditions being identical, no weed growth remained (See Plat 4).

The average growth of the past season, for the different species, with the number of trees, exclusive of seedling ash planted last spring, is as follows:

79 Spruce (*Picea alba*)	Average	growth	1 inch
17 Scotch Pine	"	"	3 inches
102 Green Ash (*Fraxinus viridis*)	"	"	12 inches
335 *Populus certinensis*	"	"	33 inches
502 Box Elder—			
Average growth of '88 planting			36 inches
" " " '90 "			24 inches

Total in plat, 1035.

PLAT 2.

The following diagram will show the arrangement of the trees in this plat:

B	A	B	E	B	W	B
C	B	C	B	C	B	C
B	E	B	W	B	A	B
C	B	C	B	C	B	C
B	W	B	A	B	E	B
C	B	C	B	C	B	C
B	A	B	E	B	W	B
C	B	C	B	C	B	C

B—Box Elder (*Negundo aceroides*).
C—Cottonwood (*Populus monilifera*).
E—White Elm (*Ulmus Americana.*)
A—Green Ash (*Fraxinus viridis.*)
W—Black Walnut (*Juglans nigra.*)

In several rows *Populus nolester* was substituted for cottonwood, and in a few places black wild cherry was substituted for black walnut.

A much better growth has been secured in this plat than in dlat 1, resulting in a denser shade and less weed growth. The tendency of weed growth to take possession of the ground is clearly shown in this plat, where a few blanks of considerable area have been formed. The cottonwood averages fully three feet taller than any other species in the plat, many specimens being three inches in diameter at the butt. The cottonwood leaf beetle has been more prevalent this season than ever before. Appearing in July, it fed through the month of August, and severely checked the growth of the trees. Late in September a new growth began, and the trees now (Oct. 20) show young leaves at the ends of the branches. This new growth has been slight, only from one to three inches, but being unseasonable it may result in winterkilling.

Populus nolester, a Russian form, seems less successful than the more common *Populus certinensis*. It is a much slower grower than cottonwood, is not so strong, but seems less inviting to the leaf beetle. Of the walnuts planted, but two in the entire plat survived and these made poor growth. The blanks in this plat, and in plats 4, 6, 8 and 10, were planted with choke cherry seed last fall. The seed germinated freely but all the trees were destroyed by cut-worms. The weed growth differed from Plat 1 only in there being fewer weeds.

It will be noticed that the hard wood trees in this plat are elm and ash (the walnut having failed), and the temporary or nurse trees are cottonwood and box elder. Already the mixture is proving itself a poor one, for the cottonwood demands more light than any other species in the plat, and grows most rapidly, not only in youth but in age. Its foliage is thin, and its shade is not dense, so that it is the poorest species in the plantation for preventing weed growth. By overtopping the more valuable elm and ash trees it will tend to check their growth, and thus really hinder instead of aid their development. The box elders used in this plat were nearly all one year old when set (spring of '89) and a poor stand was secured, but the trees that made a good start the year they were set have made a good growth, and have winter killed very little, while those that made a feeble growth have winter killed quite badly, and are hardly yet in a thrifty condition.

This suggests the importance of *careful setting* at a time when *sufficient moisture for growth* is assured, and thorough cultivation the first season.

330 Cottonwood and *P. nolester*, average height 9 ft., highest cottonwood 12 ft., 6 in. 243 Box elder, av. height 6 ft., tallest tree 9 ft. 10 in. 111 White elm, av. height 3½ ft, tallest tree 9 ft. 6 in; 28 elms over 6 ft. high. 121 Green ash, av. height 4½ ft., tallest tree 7 ft. 4 in; 22 ash over 6 ft. high.

The average growth for the year was: ash 18 inches; box elder 38 inches (killed back in winter of '90-91, on average 12 inches); elm, 28 inches; cottonwood 33 inches (severely checked by leaf beetle). Total trees in plat, 805.

PLAT 3.

This plat consists of European larch and box elders, planted alternately throughout the plat. Larch trees 6 to 8 inches high were bought and grown in nursery rows one year, then transplanted in the plat. Yearling box elders were used, except a few two-year-olds. As will be seen by referring to our Bulletin No. 20, many larch trees were killed by a late storm in May 1890. The survivors have shown peculiarities in growth that are of interest. Only a very few of the trees have developed a leading branch, and made strong upward growth. Almost all have made good growth of latral branches, which are horizontal and near the ground. The few that have begun vertical growth, first made a similar latral development, so that it is probable the remaining ones will develop "leaders" during the next few seasons. The plat is the poorest in the plantation, both in the number and condition of its trees. The larch have grown slowly, and at the first a good stand of box elders was not secured, so that there has been nothing to catch the snow, and the ground has been bare during the winters. In the summer the slight shade has not been sufficient to keep down weed growth, and though the plat was cultivated two times more than the remaining ones of the planting of '89, it now contains the most weeds. The principal weed is *Setaria viridis*, fox tail grass; the wild licorice, *Glycyrrhiza lepidota*, and wild rose, *Rosa blanda var. Arkansana*, weeds with very tough underground stems, are more common in this plat than in any other. They are extremely difficult to exterminate, nothing but continued scalping seems effective, and three years of this treatment has not entirely cleaned the forest plats of them.

Last spring the blanks in this plat were filled with yearling ash trees, almost all of which have lived. The plat contains 208 larch trees, average height 15 in., tallest tree 4 ft. 6 in; and 529 box elders, average height 3 ft., tallest tree 10 ft. Total in plat 737.

PLAT 4.

B B B B

P B Y B

B B B B

Y B P B

B B B B

P B Y B

B B B B

Y B P B

B B B B

B—Box Elder.
P—White Pine (*Pinus strobus.*)
Y—Yellow Birch (*Betula lutea.*)

This plat illustrates more graphically than any other, the importance of securing a good stand the first season. Six rows crosswise of the plat were set with yearling box elders, direct from a nursery, and in the next seventeen rows two-year-old box elders that had been once transplanted, were used. In the first six rows a very poor stand was secured, while of the two-year-old trees less than a dozen failed. This may not indicate the superiority of two-year-old trees so much, as it does the importance of having the plants in the best condition at the time of setting. The two-year-old trees were transferred from nursery row in the experiment grounds direct to the plats, while the yearlings were shipped in. The two-year-olds had much better roots, however, and presumably were better able to make a vigorous growth at once. Thus far at the Station the most vigorous seedlings have become more quickly established and have grown better than the smaller ones; and this indicates that it pays to buy first sizes of yearling trees.

This plat also shows the value of rapid growing dense-shading trees. Among the two-year-old box elders mentioned the latral branches were cut back in June, so as not to interfere with the cultivator, but by September the branches were slightly interlaced, and the ground was so shaded that no weeds grew, though the more open parts of the plat, with the same cultivation, supported a considerable growth of weeds.

The white pine is practically a failure. While there are forty-nine pines alive, none have made over five inches of growth in the three seasons they have stood in the plat. They merely send out a new tuft of leaves in the spring. Possibly they will do better after a few years, but from their action thus far they cannot be recommended. A few Colorado Blue Spruce were set last spring where pines had failed, and these have become well established.

The yellow birch has made satisfactory growth the past season, and no trees of the species have died since the first season. Being a native of much cooler and moister regions, it was feared this tree would not stand here, but thus far it has done well. The specimens that stand among the largest box elders are not doing as well as those that stand where they have more sunshine. The birches are light-demanding species, and succeed best in full sunshine.

SUMMARY.—The plat contains 877 box elders, those two years old when set now average nine feet high, the tallest being eleven feet. Yearlings when set average four feet high. Greatest growth of box elder for the year, 57 inches. Average growth for year 36 inches. 105 Yellow birch, average height, 54 inches; tallest. 8 ft. 2 inches; average growth, 30 inches. Forty-nine white pines; very little growth in three years. Eight Colorado blue spruce (*Picea pungerns*), set spring of '91. Total number of trees in the plat, 1039.

PLAT 5.

E	B	O	B	E	B
B	B	B	B	B	B
O	B	E	B	O	B
B	B	B	B	B	B
E	B	O	B	E	B
P	B	B	B	B	B
O	B	E	B	O	B
B	B	B	B	B	B

B—Box Elder (*Negundo aceroides*)
E—White Elm (*Ulmus Americana*)
O—Burr Oak (*Quercus macrocaupa*).

In this plat, as in the last, box elder is used as a nurse tree, the permanent form being white elm and burr oak, both of which species are indigenous in this county.

The elm seems to be especially adapted for cultivation in prairie regions. It is hardy and a rapid grower. It has several peculiarities in youth which are apt to bother the grower. The first is a tendency to form forked branches, the two parts being of such equal strength that one is always tempted to begin pruning at once. In our plats this tendency is already apparent, but in the large trees, one branch always gets the lead of the other, and carries the trunk upward, so that there is but little danger of splitting. The most destructive pest that has yet troubled the elm is the jack-rabbit, which peels the trees from a point just above the ground. The inner bark of the elm seems a favorite food of the rabbit, and as it is tough and stringy, instead of breaking like the bark of the apple, for instance, it is pulled off in long strips. So that girdling this tree is much more destructive than the barking of other species. Very few elms have been killed, but they have been so injured that new shoots have sprung from crown buds, and thus many specimens consist of of a number of shoots, instead of one upright trunk. Last year the rabbits commenced barking the elms in October, and before anyone thought of danger to the trees a good deal of mischief had been done.

Less than half the oaks grew. Small trees, 12-24 inches, were planted. The first year many grew from stem buds, but in most cases the second spring the trees threw up shoots from the ground, and these will form the trees. The specimens are in fine condition. Their growth is slow, but they have large healthy leaves and promise well.

As in the other plats, wherever the box elders have stood well from the first their dense shade has prevented weed growth since cultivation ceased, but where the box elders are too small to shade the ground considerable growth of purslane, foxtail, and a few other weeds has appeared.

SUMMARY.—The plot contains 872 box elders, averaging 4 ft. 6 in. high, tallest 10 ft. 6 in. 164 elms, averaging 3 ft., tallest 8 ft. 11 inches. 46 burr oaks, averaging 20 inches, tallest 3 ft. 2 inches. Total 1102 trees, exclusive of ash, with which all blanks were filled in the spring of 1891.

PLAT 6.

P	A	P	A	P	A
E	P	E	P	E	P
P	A	P	A	P	A
E	P	E	P	E	P
P	A	P	A	P	A
E	P	P	P	E	P

P—*Populus certinensis*, (A Russian Poplar).
E—White Elm, (*Ulmus Americana.*)
A—White Ash, (*Fraxinus Americana*).

In this plat certinensis poplar is used as a nurse tree instead of box elder, and the permanent trees are brought closer together than in any of the plats before described. As has been said, the poplar is not well adapted for use as a nurse, because it is a light demanding species, and because its shade is not dense enough to entirely prevent weed growth. The leaf beetle has checked the groweth of the poplars very seriously, but they have showed astonishing vitality. Notwithstanding the trees have been badly injured by leaf-beetle (*Lina scripta*) for three successive seasons, very few have died, though the growth has been greatly checked. Owing to the excellent stand in this plat, a good shade has been formed, and weed growth has been less than in plats where the box elder has been used, but has not grown well. Certinensis poplar is more dense and upright than the cottonwood, and so makes a heavier shade. Both the elm and ash have thus far grown well with the poplar.

SUMMARY.—The plat contains 688 poplars (in a few rows the poplar was substituted for elm or ash), average height 6 feet tallest 8 ft. 2 inches, average growth this season 2 feet; 277 white ash, average height 3 ft. 9 inches, tallest 6 ft. 6 inches; 344 white elm, average height 5 feet, tallest 8½ feet, average growth this season 2½ feet; total 1309 trees.

PLAT 7.

E	B	C	P	A	B	W	P	E	B
B	P	B	B	B	P	B	B	B	P
C	P	A	B	W	P	E	B	C	P
B	P	B	B	B	P	B	B	B	P
A	B	W	P	E	B	C	P	A	B
B	P	B	B	B	P	B	B	B	P
W	P	E	B	C	P	A	B	W	P
B	P	B	B	B	P	B	B	B	P
E	B	C	P	A	B	W	P	E	B
B	P	B	B	B	P	B	B	B	P

E—White Elm, (*Ulmus Americana*).
B—Box Elder, (*Negundo aceroides*).
B—Black Wild Cherry, (*Prunus serotina*).
A—White Ash, (*Fraxinus Americana*).
W—Black Walnut, (*Juglans nigra*).
P—Poplar (Russian varieties).

In this plat the elm and ash have grown better than in any other, probably owing to the fact that the snow has drifted more among the trees and remained longer on the ground in spring. This is the only plat save one in which the walnuts have done anything at all. Only 14 walnut trees, two of which are white walnut (*Juglans cinerea*) and the remainder black, are standing. They seem to have become established and will probably grow without further trouble, though it has taken three years for most of them to gain a foothold. The mixture of poplar and box elder in the nurse-rows is not so satisfactory as box elder alone. As in other plats, where the box elder has killed back weeds have sprung up since cultivation ceased. No great weed growth has been made however, and the cultivation of next spring will easily over come it. The soil throughout the plantation is in very fine condition.

SUMMARY.—The plat contains 75 elm trees, averaging 5 ft. high, 38 of which are 6 ft. high or more, the tallest being 10 ft. 2 in.; 55 black wild cherry, averaging 4 ft. high, with 9 over 6 ft., the tallest being 7 ft. 1 in.; 83 white ash, averaging 4 ft. 9 in. the tallest 7 ft. 8 in.; 14 walnut, averaging 18 in., the tallest being 3 ft. 7 in.; 573 box elder, averaging 5 ft. 6 in.; the tallest being 10 ft. 7 in.; 313 poplars averaging 4 ft. 6 in. Total 1113 trees.

PLAT 8.

B	C	P	C	B
M	C	M	C	M
P	C	B	C	P
M	C	M	C	M
B	C	P	C	P
M	C	M	C	M
P	C	B	C	P
M	C	M	C	M

B—White Birch, (*Betula alba*).
M—Silver Maple, (*Acer dasycarpum*).
P—Scotch Pine, (*Pinus sylvestris*).
C—Cottonwood, (*Populus monilifera*).

As in other plats where different poplars have been used as nurse trees, the result here is not as satisfactory as where box elder has done well. It was thought the silver or soft maple might prove valuable as a nurse, but it is more tender than box elder, and thus far has not proven as satisfactory as that variety in any other way. Last winter the box elder killed back where not protected by snow, but the box elder, unless very much injured, will send up one stem from below the dead place, and thus form a single trunk; the maple is rather more tender, and it sends up a member of shoots from below the dead line, thus giving it a bush rather than a tree form. It may be, as the trees mature that one of these shoots will overcome the others, thus forming a good trunk, but the tendency is the other way.

The white birch thus far equals, if it does not surpass the yellow birch in hardiness and in growth. It is a beautiful tree, and a few specimens will be valuable for this reason, though the species is not considered a useful forest tree, not attaining large size.

Of 170 Scotch pines originally planted, 84, or about one half, are now standing. Not more than half of these are in good condition. Last spring the blanks in the pines were reset with fine trees from our own nursery. Great care was taken in transplanting, but extremely dry weather followed, and very few of the transplanted trees lived. The Scotch pines that are well established are making satisfactory growth and seem better adapted for cultivation on the prairies than any of the conifers yet tried at the Station.

The cottonwoods in this plat are similar in growth and condition to those already noted.

SUMMARY.—This plat contains 110 white birch, averaging 5 ft. high, of which 58 are over 6 ft. high, the tallest being 8 ft. 6 in.; 84 Scotch pine, averaging 18 inches, of which the tallest is 4 ft.; 165 maple averaging 4 ft., of which 17 are over 6 ft., the tallest being 7 ft. 3 in.; 99 green ash (substituted for maple); 560 cottonwood and other poplars, the cottonwoods averaging 9 ft. Total trees 1018.

PLAT 9.

C	B	W	B	E	B	Bi	B	A	B
S	P	P	P	S	P	B	P	P	P
W	S	S	S	Bi	S	A	S	C	S
P	B	S	B	B	B	P	B	S	B
E	P	Bi	P	A	P	C	P	W	P
B	S	B	S	P	S	S	S	B	S
Bi	B	A	B	C	B	W	B	E	B
S	P	P	P	S	P	B	P	P	P
A	S	C	S	W	S	E	S	Bi	S
P	B	S	B	B	B	P	B	S	B

C—Black Wild Cherry, (*Prunus serotina*).
S—Red Willow, (*Salix fragilis*).
W—Black Walnut, (*Juglans nigra*).
P—*Populus certinensis*.
E—White Elm, (*Ulmus americana*).
B—Box Elder, (*Negundo aceroides*).
Bi—White Birch, (*Betula alba*).
A—White Ash, (*Fraxinus Americana*).

In this plat a Russian willow was used with a Russian poplar and the box elder as nurse trees, the three species alternating in the rows. The mixture has nothing to recommend it, the willow being the poorest form in the plantation. Instead of forming a trunk, the willow branched freely from the ground, growing in the form of a bush in which the diameter equaled the height. It will be noticed that the ash and elm, which in all the plats have stood better than the remaining hard woods, have made less growth in this plat than in any other. This is due in large measure to the willow, which has grown very rank, though not in tree form. This willow would make an excellent wind-break or screen, but it is infested with the cottonwood leaf beetle (*Lina scripta*), though not to such a degree as the poplars. The willow makes a denser shade than cottonwood, but not so dense as box elder, which it only surpasses in hardiness. As a nurse tree box elder is to be preferred. In this plat ash and elm were substituted it part for walnut and birch.

The poplar has not grown as well in this plat as in plat 6, owing probably to the spreading roots of the willow. The box-elder has done better, relatively, than any of the other species. The general indications, however, are that this willow is not suitable for mixing with other trees.

SUMMARY.—This plat contains fifty elm trees, averaging 3½ feet, ten of which are over 6 ft. high, the tallest being 8 ft. 2in.; 67 ash averaging 3 ft. 8 in., three over 6 ft. high, the tallest being 6 ft., 4 in.; 35 cherry averaging 3 ft. 6 in., of which only one was six ft.; 24 birch, of which 7 were over 6 ft., the species not in as good condition as in plat 8; 3 small walnuts; 235 red willow averaging 5 ft. high, very few being as much as 7 ft. high, much branched and bushy; 289 poplars, averaging 3½ ft., not thrifty; 256 box elder, averaging 5 ft., the tallest being 9 ft. 10 in. Total trees in plat 959.

PLAT 10.

C	B	E	A	C	
B	E	A	B	B	
E	A	B	C	E	C—Black Wild Cherry (*Prunus serotina*).
A	C	C	E	A	B—Yellow Birch (*Betula lutea*).
C	B	E	A	C	E—White Elm (*Ulmus Americana*).
B	E	A	B	B	A—White Ash (*Fraxinus Americana*).
E	A	B	C	E	
A	C	C	E	A	

This is the only plat in the plantation that is composed entirely of hardwood trees. And while from the stand point of a quick soil cover the mixture is not so useful as one in which a rapid growing soft wood has been largely used, yet it is a question whether the greater value of the thinnings will not more than pay for added cultivation necessary. The plat has been freer from weeds, after being two times cultivated this year, than plat 8, in which cottonwood is used for the nurse trees. The shade cast by birch and cherry is dense, and nothing grows beneath them, the ash at its best is a thin-foliaged tree, and makes but little denser shade than the cottonwood. The elm while young does not form a dense head, but its shade is quite thick as it grows older.

The arrangement of trees in the plat has already proven to be faulty. As planted, birch and cherry stand beside each other, leaving the two poorer shade makers together, and thus making a place where the soil will remain uncovered and grass and weeds will grow. A better arrangement would have been to alternate cherry, elm, birch, and ash, thus placing a light foliaged species between two dense foliaged kinds.

As regards the action of the hard woods when planted together, no difference has been observed in their growth between this and other plots, with the possible exception of the ash, of which fewer trees have reached the height of six feet. The black wild cherry has only developed the tree form in few instances as yet. Most of the trees of this variety consist of a mass of branches, which start from the trunk within a foot of the ground, making the tree as great in diameter as in height. A few specimens show leading branches, and these indicate the tendency of the species. Both white and yellow birch are spiral in shape, and they hold their foliage later than any other deciduous species. Thus far they have withstood the extreme drouth of our autumns as well as any species, though they are natives af a cool damp climate. Fewer birches survived the first year than any other species, but once established they have proven satisfactory. It is yet too early to recommend them without qualification.

Summary.—The plot contains 252 wild cherry, averaging 4 ft. in height, of which 20 are 6 ft. or over, the tallest being 7 ft. 3 in.; average growth for the year 2 ft., greatest growth 39 inches; 171 birch, averaging 5 ft. 6 in., 90 over 6 ft., the tallest being 9 ft. 7 in.; average growth 2½ ft., greatest growth 56 in.; 329 elm, averaging 5 ft., 88 over 6 ft., the tallest being 8 ft. 6 in., average growth 2 ft., greatest growth 50 inches; 301 ash averaging 4½ ft., 13 over 6 ft., the tallest being 7 ft. 2 in., average growth 18 inches.

In addition to the hardwoods the plat contains 147 Populus certinensis and 47 evergreens, which have been set in blanks. Of the conifers the principal species used is Pinus ponderosa, set last spring, and hence only established. A larger per cent of it has lived after transplanting than any other conifer tried at the station.

Total trees in plat 1247.

THE SEEDLING PLAT.

In this plat, containing 2 acres, 49 rods, fourteen varieties of forest tree seeds were planted in the fall of 1887. The following varieties survive: walnut, black wild cherry, green ash, box elder, hard maple (acer saccharum). The plat is high ground with a northern exposure, and but little snow lodged in it last winter. The hard maple and walnut were measurably protected by the snow, but the cherry, ash and box elder were practically without protection. The cherry killed back but very little. The ash came through the winter without injury, but the box elder was badly injured, in many cases all the growth of the previous season was killed. The tallest box elder in the plat is 9 ft. 6 in. high, average height 6 ft. 6 in., average growth for the year 3 ft. Compared with the oldest box elders in plat 1—10, which were brought when one year old in the spring of 1888, grown one year in nursery rows and then transplanted to their present position, the seedlings of '87 are not so large, but they average better than the yearling trees that were set in the other plats in '89.

The green ash trees in this plat average 4 ft. 3 in. high, the tallest being 7 ft. 2 in., and the average growth for the year 16 inches. The ash trees number several hundred, and they are all in fine condition.

The hard maples are few in number and have made but little growth, the tallest being 12½ inches high. Cherry and walnut are about equal in size and growth to the same species grown in the forest plantation.

In 1889 and again in 1890 the blanks in this plantation were filled in with box-elder, elm, certinensis popalar, laurel leaved willow, birch, Norway popular (*P. tremuloides ?*) and Scotch pine. The certinensis popular has not grown as well in the high, poorer soil of the seedling plat as it has in the plantation. Elm and the Norway popular (a popular received under this name from the nursery, but evidently one of the aspens, probably *P tremuloides*) have done well, and the laurel leaved willow has grown very well. Its glossy leaves make it a noticeable object in the plat. It is visited by the cottonweod leaf beetle, which does it less injury than either cottonwood or certinenis poplar.

The birches do not thrive in this plat as they do in the lower, richer soil of the plantation.

The small plat of Scotch pines, in which 342 trees were set in the spring of 1890, showed more than any other of the forest plants the effects of the very dry autumn and open winter. In the fall, as noted in Bulletin No. 20, 285 pines were in good condition. Of these not more than twenty-five survived, and less than a dozen are in good condition.

The land in which they stood is a gravelly knoll, and they were set there to test the adaptability of the species in the severest way. Evidently the tree requires a moister soil than the gravelly ridges furnish.

Comparing this seedling plat, which is on and near the ridge of a long northern slope, with the forest plantation, which is in low land at the base of a similar eastern slope, we find the trees in the lower land as a rule larger, and in better condition, having been less injured by winter-killing. The soil in the plantation is deep and contains little gravel. That in the seedling plat is comparatively thin and is underlaid with a gravel stratum, under which is the stiff clay, which also forms the sub-soil in the plantation.

It is of far greater importance, however, to cover the ridges of prairies with trees than to grow them in the richer lowlands. They are not only more effective as wind breaks when placed on ridges—protecting thus a far greater area—but they are immeasurably more useful in saving snow water when planted in the higher ground. And so, while observations thus far point to greater success with trees grown in the rich low lands, the plat in the higher ground demonstrates that, while growth is slower, trees can be grown in the poorer soil of the knolls, and some varieties, notably the ash and aspen, seem to flourish there.

GROWTH FROM SEEDS.

The work with tree seeds has been very unsatisfactory the past two years owing to drouth at the critical time of germination, and to the pest of cut worms, which destroy the young seedlings. Last fall seeds of choke cherry (*Prunus Virginiana*) were planted in all the blanks of the even numbered plats from 2 to 16 inclusive. The seed germinated well in the spring, but while the little plants were less than two inches high they were all destroyed by cut worms. The choke cherry is a slow grower, and succeeds in partial shade, and it was thought it would make a more complete leaf canopy with the larger forms, besides attracting birds with its fruit.

Early in the spring a large quantity of box elder and green ash seed, which had been frozen over winter, were sown in drills, and germinated well, but all were destroyed while in the seed leaf by cut worms.

In districts where the cut worms are numerous, it would seem inadvisable to plant seeds, as there is no known way in which to prevent the distruction of the seedlings by the worms, especially if they are planted in drills or where the trees are to stand in the forest plat. It is probable that in the course of a few years the pest will pass away, when it will be again advisable to sow seeds. Meanwhile the planter will find it more economical to buy seedlings.

Conifer seed planted early, failed to germinate. Shortly after the seed were sown dry weather came on, and this was doubtless the reason.

For the purpose of comparison, a table of average growths of varieties in plats, 1 to 10 inclusive, for the years 1889, 90 and 91 is here given. All the figures are averages, determined by measuring a number of leading branches on the trees showing the greatest, least and average growth, and working from these data. They will not therefore correspond to the figures in the notes.

Variety.	Total Growth in Inches.								
	1889.			1890.			1891.		
	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
Populus pyramidalis	23	10	16	40	18	36	43	16	35
Populus Nolester	80	5	18⅛	38	18	35	46	20	37½
Black Walnut	7½	1½	4¼	9	3	6	20	6	18
White Walnut	9¾	1¼	6¼	....	....	....	....	....	....
Yellow Birch	10	3	6	30	7	20¾	36	9	21
White Oak	5	1	1⅜	9	2	5½	13	7	10
White Birch	7¾	2½	5¼	29	12	16	40	10	23
White Elm	24	3	9½	42	10	22¾	46	15	32
Black Wild Cherry	12	4	8	26	6	16	32	20	28¾
Soft Maple	12¼	4	8⅝	35	16	22½	45	26	34½
Salix fragilis	8½	8	15¼	30	18	24	40	22	29¾
Scotch Pine	7¾	2¼	4¾	9	2	5	16	2	4
Larch	7½	2⅜	5	14	8	11⅛	16	5	11½
Black Hills Spruce	5½	1	2¾	4	1	2½	2½	2	2¼
White Pine	7½	½	4½	8	1	4½	...		...
Populus certinensis	39	9	25⅛	40	14	37	34	10	24¼
Box Elder, one year old*	32	3¼	10¾	38	10	28¾	39	22	32
Box Elder, two years old*	34	5½	18	45	20	37½	51	24	38½
Cottonwood, 1 year old*	25	4½	15½	66	16	40¼	40	19	29¼
White Ash	14	3	9¼	34	8	22¼	31	6	19

*When transplanted.

NOTES ON PARASITIC FUNGI OBSERVED AT BROOKINGS DURING THE SUMMER OF 1891.

T. A. WILLIAMS, M. A.

INTRODUCTION.

The term fungus (plural fungi) is a general one, applied to a class of flowerless plants that get their nourishment from other dead or living plants, or from animals. They contain no green coloring matter (*chlorophyll*). They are unable to manufacture their own food from the elements of the soil or air, as do most of the higher plants, but get nourishment already prepared by higher plants.

A fungus is composed of two parts, a vegetative portion, or plant body, and a reproductive portion or spore. The former usually consists of variously modified threads (*mycelium*), which spread over or penetrate into the substance upon which the fungus grows. These threads are usually more or less branched and are colorless or colored according to the kind of fungus of which they form a part.

The reproductive portion consists primarily of small bodies (*spores*) which are born on branches of the mycelium, or, in specialised bodies or *receptacles*.

From their methods of obtaining nourishment fungi are divided into two classes: Those obtaining nourishment from decaying matter. or SAPROPHYTES; and those obtaining their food from living plants or animals, or PARASITES. A parasitic fungus then is one that gets all its nourishment by robbing some other living plant or animal.

Saprophtic fungi seldom does much damage. Under proper conditions, however, some of them become parasitic or semi-parasitic in their habits and then are more or less injurious. It is to the parasitic fungi that we must look for our injurious forms. These send their vegetative threads through the tissues of other plants causing disease and often death. The plant upon which a fungus grows is called the "host plant" or the "host."

METHODS OF REPRODUCTION IN THE PRINCIPAL KINDS OF PARASITIC FUNGI.

The greater part of our injurious fungi belongs to the kinds commonly known as, THE BLIGHTS, THE MILDEWS, THE WHITE RUSTS, THE SMUTS, THE RED OR BLACK RUSTS, and THE LEAF SPOT FUNGI. In order that all may have some idea of the ways these plants perpetuate themselves, a short account of the various methods of reproduction is appended.

THE DOWNY MILDEWS AND WHITE RUSTS.

In both of these there are two kinds of spores or reproductive bodies, one kind born on mycelia within the tissues of the host plant, remains there until the tissues decay and fall away, which is usually the following spring. These spores are known as *resting spores*. They serve to carry the fungus over to the next season. That is performing the same function as do the seeds of the flowering plants. The other kind of spores (*conidia*) are born upon upright branches of the vegetative threads. In the downy mildews these spores are born outside, on the surface of the host plant, upon many-forked branches, and give the surface a light colored down-like appearance. In the white rusts the spores are developed beneath the surface of the host, forming shining white spots and later bursting through the epidermis, giving the surface a white powdery appearance. In nearly all cases this last kind of spore is produced in much greater quantities than the resting spores, and as they germinate readily serve to produce a more rapid multiplication of plants and a wider destribution than could be gained were there but the one kind of spore.

THE BLIGHTS (*Perisporiaceae*).

These fungi have reproductive organs, much like the miedews except that both kinds of spores are born on the surface of the host plant. Leaves affected by the blight appear covered with a grayish or whitish cobweb-like mass of threads or mycelia interspersed here and there with small blackish specks. If one of these specks were examined, with a compound microscope, it would be seen to have a ball-like form, usually with many slender projections coming from its surface. This ball-like body is the *resting spore.* When a mature resting spore is mashed under the microscope it is seen to contain one or more sac-like bodies filled with spores. These resting spores are provided with a thick, heavy covering to protect the spores during the winter, just as many seeds are provided with a hard shell for a like purpose.

The *conidia* of the blights are of the same color as the mycelia and are produced earlier than the *resting spores.* They are born on upright branches of the mycelia.

The mycelia of the blights grow on the surface of the host and send little branches or suckers down into the plant tissues for nourishment and to insure a good hold upon the host.

In the *leaf spot fungi* the spores are born on little upright threads or in minute blackish receptacles clustered in variously colored (usually whitish or brownish) spots on the surface of the leaf. Most of these fungi are imperfect forms and have but one kind of spore.

THE SMUTS (*Ustilagineae*).

The mycelia of the smuts grows entirely within the tissues of the host plant so that it is difficult to acertain whether or not plants are affected until the spores appear. As the mycelia develope a mass of them congregate at some place within the host plant (generally at or near the flowers or fruit) and form the spores. These when ripe show as a black powdery mass, as is seen in the smutted ear of corn or head of wheat or barley. The spores are very small, more or less rounded and black; when dry they are easily blown about by the wind and so become scattered over a large field. Many of them are covered with minute projections which enable them to adhere to the surface of plants and various other substances, and are thus carried about as sandburs or cockle-burs are.

THE RUSTS (*Uredineae*).

The rusts are without doubt the most injurious of all fungi. They are also the most difficult to destroy or prevent. This is doubtless due to their natural facilities for insuring reproduction. Normally a rust, as for example the common wheat rust *Puccinia graminis*), passes through three readily recognized stages of growth on the same host plant or on different hosts as the case may be. Stage I, known as the "Cluster Cap" stage consists of numerous small orange colored cup shaped bodies, arranged in clusters or scattered uniformly upon the surface of the host. These "cups" are filled with yellowish spores which fall upon the surface of the host plant, germinate, and give rise to stage II, or the "Red Rust" stage. This may be readily recognized in the reddish powdery masses covering the various small grains just before harvest on a bad "rust" season. The spores of this stage are born in small redish or blackish, often elongated, openings in the epidermis of the host. These are called *sori* (singular sorus). The red rust spores fall upon the host and germinate very readily producing stage III, or the "Black Rust" stage. Sometimes however the same sori that produced *red rust spores* produce *black rust spores* later in the season. Black rust is by far the most destructive of all the stages of these fungi. The black rust spores constitute the resting spores. They lie in the straw or upon the ground till spring when they germinate and produce minute colorless bodies which attach themselves to the young host plant, germinates, and the fungus starts on its round of life once more.

REMEDIES AND PREVENTIVES OF FUNGOUS DISEASES.

To combat fungous diseases successfully the greater part of the work should be done in endeavoring to prevent the disease rather than to try to cure it after it has gotten a start. While it is often necessary to treat different diseases in different ways, yet a few general suggestions can be given that may be profitably followed in most cases.

No straw or trash from infested grain should be allowed to accumulate or remain upon the ground, especially if the same crop must be planted the next year. All the refuse should be burned. Straw and stubble, from wheat affected with rust should be burned. Rotation of crops should be practiced as much as possible. Potatoes or beets should never be planted in ground where "scabby" potatoes have been raised the preceding year.

For the deseases caused by "blights," "mildews," or the "leaf spot" fungi such remedies as the Bordeaux mixture may be used with reasonable assurance of success.

This mixture is made of *lime*, *copper sulphate*, and *water*, mixed in the following proportions.

Lime,	4 lbs.
Copper Sulphate,	6 lbs.
Water,	22 gallons.

The usual way is to slack the four pounds of lime in six gallons of water; then disolve the six pounds of copper sulphate in sixteen gallons of water; as soon as they are cool mix all together well. As the lime is only held in suspension it is necessary to keep the mixture well shaken while applying it to the plants. It may be applied by means of a spraying pump. The time for spraying depends a great deal upon the season. As a rule the spraying should begin about the last of May or the first of June; this being about the time that the fungi are beginning their growth. The mixture falls upon the leaves and prevents the germination of the fungus spores and kills the young fingi where they have not yet penetrated into the host.

It has been found that a more dilute solution of the Bordeaux mixture is quite effective with such diseases as "leaf spot," "scab," &c. Mixing together 4 lbs. lime, and 4 lbs. of copper sulphate to 50 gallons of water, this is much less expensive than the first and more easily applied.

As yet no fungicide has been found that will successfully prevent rust.

Serious damage from smuts may be prevented. It has been found that the damage done to grain by smuts comes from fungi developed from spores adhering to the seed of the grain when sown. Dr. Jensen acting upon this fact treated grain with hot water and found that the fungus spores were killed and that the grain grown from seed treated thus was practically free from smut while untreated seed yielded smutted grain. Experiments carried on at the Kansas Experiment Station by Dr. Kellerman showed that grain could be raised comparatively free from smut, by treating the seed with either *Jensen's Hot Water Treatment* or a solution of *Livers of Sulphur* (Potassium sulphide). Dr. Kellerman also found that there was a considerable increase in yield of grain beyond the amount that would have been destroyed by smut. He describes the method of treating the grains as follows : *

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*(Bulletin No. 15, Kansas State Experiment Station 1890.)

DIRECTIONS FOR TREATING THE SEED.

THE JENSEN HOT-WATER TREATMENT.

"The hot-water treatment consists in immersing the seed which is supposed to be infected with smut, for a few minutes in scalding water. The temperature must be such as to kill the smut spores and the immersion must not be prolonged so that the heat would injure the grain or embryo concealed within the seed coats. If the water is at a temperature of 132½°F. the spores will be killed, and yet the immerson, if not continued beyond fifteen minutes, will not in the least injure the seed. The smut spores will possibly be killed by a ten minutes' immersion. A fifteen immersion, however is recommended. The temperature must be allowed to vary but little from 132½°, in no case rising higher than 135°, nor falling below 130°. To insure these conditions when treating large quantities of seed the following suggestions are offered:

Provide two large vessels, as two kettles over a fire, or boilers on a cook stove; the first containing warm water (say 110°—130°), the second containing scalding water (132½°).

The first is for the purpose of warming the seed preparatory to dipping it into the second. Unless this precaution is taken, it will be difficult to keep the water in the second vessel at a proper temperature.

The seed which is to be treated must be placed a half bushel or more at a time, in a closed vessel that will allow free entrance and exit of water on all sides. For this purpose a bushel basket made of heavy wire could be used, within which spread wire netting, say 12 meshes to the inch; or an iron frame could be made at a trifling cost, over which the wire netting could be stretched. This would allow the water to pass freely, and yet prevent the passage of the seed. A sack made of loosely woven material (as gunny-sack) could perhaps be used instead of the wire basket. A perforated tin vessel might be preferable to any of the above.

Now dip the basket of seed in the first vessel; after a moment lift it; and when the water has for the most part escaped, plunge it into the water again, repeating the operation several times. The object of the lifting and plunging, to which might be added also a rotary motion, is to bring every grain in contact with the hot water. Less than a minute is required for this preparatory treatment, after which plunge the basket of seed into the second vessel. If the thermometer indicates that the temperature of the water is falling pour in hot water until it is elevated to 132½°. If it should rise higher than that, add small quantities of cold water. This will doubtless be the most effectual method of keeping the proper temperature, and requires only the addition of two small vessels one for cold and the other for boiling water. The basket of seed should very shortly after its immersion be lifted and then plunged and agitated in the manner described above, and the operation should be repeated eight to ten times during the immersion (which should be continued fifteen minutes). In this way every portion of the seed will be subjected to the action of the scalding water. Immediately after its removal dash cold water over it, or plunge it into a vessel of cold water, and then spread out to dry. Another portion can be treated similarly, and so on till all the seed has been disinfected. Before thoroughly dry, the seed can be sown.

The important precautions to be taken as follows: 1st —*Maintain the proper temperature* of the water (132½° Fahr.), in no case allowing it to rise higher than 135° or to fall below 130°. This will not be difficult to do if a reliable thermometer is used and hot or cold water be dipped into the vessel as the falling or rising temperature demands. Immersion fifteen minutes will not then injure the seed. 2nd.—See that the volume of scalding water is much greater (at least six or eight times) than that of the seed treated at any one time. 3rd.—Never fill the basket or sack containing the seed entirely full, but always leave room for the grain to move about freely. 4th.—Leave the seed in the second vessel of water *fifteen minutes.*

THE POTASSIUM SULPHIDE TREATMENT.

Our experiments this year seem to show that a weak solution of potassium sulphide is nearly if not quite as good as hot water for treating oats to prevent smut. Since this method may prove more convenient than the Jensen method for treating small quantities of grain, we give directions for carrying it out. The potassinm sulphide is cheapest in the "fused" condition; it costs about 25 cents a pound. One pound of the sulphide should be dissolved in 24 gallons of water. Place the seed in a wooden vessel and pour on the solution until the seed is covered several inches deep. Stir the solution before pouring it on the grain and thoroughly mix the seed several times before taking it out of the solution. The oats should stand in the solution 24 hours after which they may be spread out to dry.

It will probably be best to sow the seed as soon as possible and before it becomes thoroughly dry."

NOTICE.

We are desirous of obtaining all the information possible concerning the fungous deseases of economic plants. All such information will be gratefully received. Specimens of diseased plants can be sent by mail at one cent for each ounce. They need only be wrapped in paper and directed to the station.

We are also anxious to get specimens of grasses and forage plants of the state together with information concerning their habits and value as forage, either for hay or grazing.

Address THE BOTANIST OF THE AGRICULTURAL EXPERIMENT STATION, BROOKINGS, SOUTH DAKOTA.

I

FUNGI CAUSING MORE OR LESS DAMAGE TO USEFUL PLANTS.

PERONOSPORACEAE.

PERONOSPORA ARTHURI, Farlow. Mildew of evening primrose. On yellow evening primrose (*Oenothera biennis*), covering the leaves with a mass of white filaments causing them to curl, lose color, and finally fall prematurely. It has been very injurious to plants in the flower gardens this season,

PERONOSPORA VIOLAE, DeBary. Violet or pansy mildew. Found rarely on pansies in flower gardens. It is very injurious.

PERISPORIACEAE. THE BLIGHTS.

PODOSPHAERA TRIDACTYLA,(Wallr.) DeBary. Cherry blight. On leaves of the common cultivated cherry (*Prunus cerasus*) and sand cherry (*Prunus pumila*). It covers the leaves with a network of fine whitish filaments, spreading over both upper and under sides. The leaves of young shoots are usually more liable to injury. The fungus was especially injurious to the sand cherry, often covering every leaf on a plant and causing eariy dropping of the leaves; thereby hindering the proper developement of buds and ripening of the wood. June—September.

SPHAEROTHECA PANNOSA, (Wallr.) Lev. Rose blight. This fungus has been observed but a few times on leaves of wild rose (*Rose arkansana*) and once on leaves of cultivated roses. It has caused little or no damage so far. July.

SPHAEROTHECA MORS-UVAE, (Schw.) Berk. and Curtis. Gooseberry and currant blight, on leaves of cultivated gooseberry, and wild black currant (*Ribes floridum*). Not common enough to be injurious. June.

MICROSPHAERA ALNI, (DC.) Winter. Lilac blight. On leaves of lilac (*Syringa vulgaris*). Räre. Causing but little damage. June—July.

ERYSIPHE COMMUNIS, (Wallr.) Fr. Pea blight. Common on leaves and stems of garden peas. This fungus was not so destructive this season as it has been in previous ones. It often becomes a serious pest. June—July.

PYRENOMYCETES. THE BLACK FUNGI.

SPHAERIA ULMAE, Schw. On leaves of White Elm (*Ulmus americana*). It forms irregular blackish spots on the leaves but appears too late in the season to do much damage.

PHYLLACHORA GRAMINIS, (Pers.) Fkl. Leaf spot. Forming elongated black spots on the leaves of Muhlenberg's grass (*Muhlenbergia mexicana*) and rice-cut-grass (*Leersia virginica*). Although the fungus is very plentiful it seldom does much injury as it generally appears late in the season when the leaves are dead or dying from frost.

PLOWRIGHTIA MORBOSA, (Schw.) Sacc. Black-knot. On limbs of wild plum (*Prunus americana*) and choke cherry (*Prunus virginiana*), causing great black swellings, deforming and finally killing the limbs. Very common and injurious. In many states this fungus has become so bad on cultivated plums as to completely ruin large orchards. The only remedy is to cut off and burn all deseased parts year after year, taking care that no affected parts are allowed to remain over from one season to another.

DISCOMYCETES. THE CUP-FUNGI.

RHYTISMA ACERINUM, (Pers.) Fr. Black leaf spot of maple. On living leaves of soft or silver maple (*Acer saccharinum*), forming large, irregular, thickened, black, areas. Thus far this fungus has not been plentiful enough to be very injurious. It has been known to completely strip large groves of maple in Nebraska. June to September.

Rhytisma salicinum, Fr. Black leaf spot of willow. On living leaves of diamond willow, (*Salix cordata var vestita*), forming spots as described in the preceding. It was found quite plentifully this season and did considerable damage. July—October.

UREDINEAE. THE RUSTS.

Uromyces trifolii, (Alb. & Schw.) Winter. Clover rust. On leaves of mammoth red clover (*Trifolium pratense var.*) grown in the experimental plats on the College farm. It was found but once and was not very plentiful but did considerable damage to the host.

Melampsora farinosa, (Pers.) Schroet. Willow rust. Very plentiful on the leaves of nearly all our common willows. During the summer the leaves become covered with small powdery spots of orange yellow spores. These spots become brown or black later in the season. The fungus has been very destructive this year, having much to do with the early falling of the leaves.

Melampsora populina, (Jacq.) Lev. Cottonwood or poplar rust. Common on leaves of cottonwood (*Populus monilifera*) and the various species of poplar growing on the college grounds. Similar in appearance to the willow rust but not so injurious, this year. A few trees were noticed badly damaged.

Puccinia coronata, Corda. Oat rust. II and III on leaves, sheaths and stems of oats. This rust occurred but rarely, and did but little damage compared to the next.

Puccinia graminis, Pers. Grain rust. II and III. Common on wheat, cats and many grasses. It has not been very destructive to small grains this year, as it appeared rather too late. A few fields of late wheat were found that were more or less damaged. It has been very destructive to the wheat grasses, (*Agropyrum glaucum*, *Ag. caninum*, and *Ag. ten-*

crum) especially to the latter species. Squirrel-tail grass (*Hordeum jubatum*) was also very badly affected. Several farms were noticed where wheat grass and squirrel-tail were so badly affected that there is no doubt that their stems and leaves contained enough rusts pores to "seed" thousands of acres of grain. Were these grasses carefully collected and burned most of these spores would be destroyed. It is probable that such grasses as these aid materially in causing many damaged fields of grain.

PUCCINIA PRUNI, Pers. Plum rust. III. On leaves of wild plum (*Prunus americana*). Rare. It is very injurious when abundant.

PUCCINIA STIPAE, Arthur. III. On porcupine grass(*Stipa spartea*). It causes but little damage.

PUCCINIA VIOLAE, (Schum.) DC. Violet rust. I-III. On leaves of common wild violet (*Viola cucullata*). It often becomes very injurious. May—July.

ACCIDIUM FRAXINI, Schw. Ash rust. On leaves and petioles of green ash (*Fraxinus viridis*) Quite common and destructive. Often greatly distorting the affected parts. June—July.

AECIDIUM GROSSULARIAE, Schum. Gooseberry or currant rust. On leaves and berries of common gooseberry (*Ribes rotundifolium*), and black wild currant (*Ribes floridum*). Abundant. Very destructive, especially when the fruit is affected. Many bushes were noticed with scarcely a leaf or fruit unaffected. May—July.

UREDO CAEOMA-NITENS, Schw. Blackberry and Raspberry rust. Covers the whole under surface of the leaves with an orange red powder (the spores). Does much damage to the host wherever found. Happily it is as yet quite rare here.

USTILAGINEAE. THE SMUTS.

USTILAGO AVENAE, (Pers.) Jensen. Loose smut of oats. In heads of oats, causing them to turn to a black powdery mass, totally ruining the grains. Quite common and very destructive. Damaged some fields considerably this year.

USTILAGO HYPHODYTES, (Schlect) Fr. Grass smut. Destroys the tissues of the stem within the sheaths. Found but once on porcupine grass, (*Stipa spartea.*)

USTILAGO MAYDIS, (DC.) Corda. Corn smut. On ears, stalks, and tassels of corn. Often totally destroying the ear. It has not been plentiful enough to cause much damage.

USTILAGO NUDA, (Jensen) Kellerm & Swingle. Naked smut of barley. Often causing the complete destruction of barley heads. Several fields were observed to be quite badly afflicted by this smut.

USTILAGO TRITICI, (Pers.) Jensen. Loose smut of wheat. Similar in appearance and effects to the preceeding species. Common and destructive. Some fields were badly damaged the past season.

SPHAEROPSIDEAE.

VERMICULARIA DENUDATA, Schw. (?). On leaves and stems of Kentucky blue grass (*Poa pratensis*) and wire grass (*Poa compressa*). Usually not very destructive as it is most plentiful rather late in the season. In a few instances it did considerable damage to Kentucky blue grass.

STEGONOSPORA SPINACEAE, E. & E. (*n. sp. in lit.*). Leaf spot of spinach. This species was discovered on leaves of spinach in the college gardens the past season. It forms circular grayish spots on the leaves, causing them to be unfit for use, and finally, to fall off. *Very destructive.* Found usually in company of *Peronospora effsua.*

SEPTORIA PRUNI, Ellis. Leaf spot of the plum. On leaves of common plum (*Prunus americana*), giving them a spotted appearance, not pleasant to behold, and damaging them considerably.

SEPTORIA RIBES, Desm. Gooseberry and currant leaf spot. Quite abundant on leaves of gooseberry (*Ribes rotundifolium*), and wild black currant (*Ribes floridum*). Many instances of its destructive character have been observed this season, particularly on the wild black currant.

Septoria rubi, West. Raspberry leaf spot. Not uncommon on leaves of both wild and cultivated raspberries. It sometimes becomes destructive.

Piggotia fraxini, B. & C. On leaves of green ash (*Fraxinus viridis*). It forms irregular black patches on the leaves, and though most plentiful on the fallen leaves, has been very destructive to the fresh ones this year. It has been one of the chief agents in stripping the trees so early in the season.

HYPHOMYCETES.

Oidium erysiphoides, Fr. Mildew. On leaves of turnip, causing them to appear as if covered with flour. Apparently not injurious.

Ramularia armoraciae, Fuckel. Leaf spot of horseradish, (*Nasturtium armoracia*). Frequently doing a great deal of damage to the leaves. Many of these may be found with the spots completely covering the surface; the whole leaf having a whitened appearance.

Ramularia tulasnei, Sacc. Strawberry leaf spot, or Strawberry blight. On leaves of both wild and cultivated strawberries, common. Some varieties of cultivated strawberries are almost free from blight, while others are always more or less affected. When a patch becomes infested with this fungus all the affected leaves should be collected and burned. Some growers recommend burning over the entire patch once a year. This, however, should not be done if the ground is very dry, but if the soil is moist and a good wind blowing, it may do, great care is necessary at all times.

Scolecotrichum maculicola, Ell. & Kell. Causing spots on leaves of reed grass, (*Phragmites vulgaris*).

Cercospora beticola, Sacc. Leaf spot of beet. Common on leaves of garden beet, frequently becoming quite injurious. Causes the leaves to curl and dry up.

Cercospora circumscissa, Sacc. Leaf spot of cherry; gun shot disease. On leaves of wild and cultivated cherries. The fungus forms brownish spots, which after a time, fall out, leaving the leaves as if perforated by shot holes. • Often very destructive.

CERATOPHORUM ULMICOLUM, E. & K. Elm leaf spot. Not very common, and not very destructive. On leaves of elm (*Ulmus Americana*).

II.

BENEFICIAL FUNGI.

The fungi classed under the above head include those parasitic species damaging weeds, and injurious plants, hence they are to be classed as beneficial to the farmer.

ENTOMOPHTHORACEAE. THE INSECT FUNGI.

Empusa muscae (Fr.) Cohn. Fly fungus. On the common house fly. It has been very plentiful here this year, appearing earlier than usual. The affected flies may be readily recognized,as they attach themselves to the walls, curtains, &c., and soon become more or less distended,and covered with a whitish powdery substance (the spores). After hanging for some time in this manner they become surrounded by a white circle of spores.

PERONOSPORACEAE.

Peronospora cyparissiae, DeBary. Mildew of spurge. On leaves and stems of spurge (*Euphorbia spp.*). Showing as a violet tinged mildew on the affected parts. It causes the plants to assume an upright mode of growth,(Conidia deeply tinged with violet; 13½—18u, Ellipsoid). Very plentiful. The affected plants were usually quite badly damaged.

Peronospora leptosperma, DeBary. On under side of leaves of wormwood (*Artemisia biennis*). Common. Frequently doing considerable damage to the host by causing the leaves to turn yellow, dry up, and fall off. July—September.

Sclerospora graminicola, (Sacc.) Schroet. Mildew of grass. Very common this season on fox tail (*Setaria viridis*). It appears usually, on the upper leaves and causes them to curl and die. The flower-spike instead of ripening the usual quantity of seed forms a bushy, leafy, mass and bears no seed at all. The fungus has kept a great many plants of this weed from "going to seed" this year.

PLASMOPARA HALSTEDII, (Farl.) Berl. and DeToni. On leaves of wild artichoke (*Helianthus tuberosus*), and marsh elder (*Iva xanthifolia*). Plentiful. This is the most destructive species of my acquaintance. Many plants were found with every leaf affected. The marsh elder is one of our commonest roadside weeds, and thousands of them were killed this season by the mildew. July—September.

CYSTOPUS BLITI, (Biv.) DeBary. White rust of pigweed. Very plentiful on common pigweed (*Amarantus retroflexus*), and the tumble weeds (*Amarantus alba* and *A. blitoides*). It forms white patches on the under side of the leaves; which break open later emitting many white, powdery, spores, hence the name "white rust." Quite injurious especially to the tumble weeds. July—October.

CYSTOPUS CANDIDUS, (Pers.) Lev. This white rust occurs upon a great number of hosts belonging to the order *Cruciferae*. It has been collectod on pepper grass (*Lepidium virginicum and L. intermedium*), hedge mustard (*Sisymbrium officinale*), shepherd's purse (*Capsella bursa-pastoris*), black-mustard (*Brassica nigra*), white mustard (*B. abla*), charlock (*B. arvensis*), and water cress (*Nasturtium hispidum*).

CYSTOPUS portulacae, (DC) Lev. White rust of purslane. Affects the under side of the leaves of purslane (*Portulaca oleracea*). Very plentiful but apparently doing little damage.

CYSTOPUS TRAGOPOGONIS, (Pers.) Schroet. On rag weeds (*Ambrosia spp.*). Common. By far the most destructive species of this genus, comparing well with *Plasm. halstedii.* In many places along the roadside and streets the weeds were completely stripped of all but the very uppermost leaves, and sometimes even these succumbed. What is probably the same species was collected on wormwood (*Artimesia biennis*), where it was equally injurious, when found in sufficient quantities.

PERISPORIACEAE. THE BLIGHTS.

ERYSIPHE CICHORACEARUM, DC. On great rag weed (*Ambrosia trifida,*) and golden rod (*Solidago spp.*). Common and often quite destructive.

URDEINEAE. THE RUSTS.

UROMYCES EUPHORBIAE, Cke. & Pk. Rust of Euphorbia or spurge. II—III on leaves of spurge (*Euphorbia serpyllifolia* and *E. hypericifolia*). One of our commonest rusts. It seldom becomes very destructive.

UROMYCES POLYGONI, (Pers.) Fuckel. I—II—III. On leaves and stems of knotweed, or door weed (*Polygonum erectum*, *P. aviculare and P. ramosissimum*). A very commons pecies often becoming quite destructive in all its stages. May—September.

UROMYCES RUDBECKIAE, Arthur & Holw. Cone flower rust. III. On cone flower (*Rudbeckia laciniata*). Forms definite raised, light brown, or brown, spots on the underside of the leaf. The tissues of the affected spot, after a time, fall away, leaving an irregular hole. When the whole leaf is affected, it rolls up and falls off. A common and destructive species. June—October.

PUCCINIA CONVOLVULI, (Pers.) Cast. Morning glory rust. II—III. On leaves of wild morning glory, or hedge bind-weed (*Convolvulus sepium*). A common and often very injurious species, often destroying nearly every leaf.

PUCCINIA EMACULATA, Schw. III. On old witch grass (*Panicum capillare*). Usually on the upper surface of the leaves, causing them to shrivel and dry up. Not uncommon, and frequently destructive.

PUCCINIA HELIANTHI, Schw. Sunflower rust. II & III. On sunflower (*Helianthus annuus, H. maximiliani, & H. giganteus*)

Very common and destructive. Often covering the entire under surface of the leaf.

PUCCINIA POLYGONI—AMPHIBII, Pers. II & III. On water persicaria (*Polygonum amphibium*), and tan weed (*Polygonum terrestre*). This species is very common, and also very destructive. It appears on the under side of the leaves, sometimes scattered indefinitely over the surface, but usually in more or less circular spots.

PUCCINIA PRENANTHIS, (Pers.) Fuckel. I, II & III. On wild lettuce (*Lactuca pulchella*). Common and destructive, especially in the first stage, which is usually found along the midribs of the leaves. The affected plants assume a much more upright mode of growth than their fellows, and seldom ripen many seeds.

PUCCINIA TARAXACI, Plow. Dandelion rust. II & III. On false dandelion (*Troximon glaucum*). Not common and not very injurious. What is probably the same thing has been collected several times on common dandelion (*Taraxacum officinale*), upon which host it is much more destructive.

PUCCINIA XANTHII, Schw. Cockle bur rust. III. On common cockle bur (*Xanthium canadense*). Forms large, swollen brownish places on the under surface of the leaves. It is quite common and frequently becomes very destructive.

PHRAGMIDIUM SPECIOSUM, Fr. Stem rust of the rose. II & III. On wild rose (*Rosa arkansana*). Very common and destructive. Stage II appears usually in June on the younger stems, petioles, and sometimes, leaves, buds and fruit, forming large, bright orange masses of spores. Stage III appears later as a black, powdery mass upon the stems.

PHRAGMIDIUM SUBCORTICIUM,(Schrank)Winter. Rose leaf rust. II & III. On leaves of wild rose (*Rosa arkansana*). Not uncommon, and sometimes becoming destructive. Sori scattered over the under surface of the leaf, giving it a powdery appearance. This species has been known to be quite injurious to cultivated roses, but so far, it has been found here only on wild roses.

Aecidium apocyni, Schw. On Indian hemp or dogbane (*Apocynum cannabinum*). Not very common and seldom injurious,

Aecidium compositarum, Mart. *var.* helianthi, Burrill. Sunflower cluster cup, or rust. On leaves of sunflower (*Helianthus rigidus and H. grosse-serratus*) common and often destructive.

Aecidium euphorbiae, Gmel. Euphorbia, or spurge rust, or cluster cup. On leaves of (*Euphorbia sp*—.). Often very injurious, completely covering the under surface of the leaves, and causing the affected plants to have a more upright mode of growth.

Aecidium jamesianum, Pk. Milkweed rust. On wild milkweed (*Asclepias syriaca* and *A. speciosa*). Very common and quite destructive, especially to the latter host.

Aecidium urticae, Schw. Nettle rust. On leaves of common nettle (*Urtica gracilis*). Rather uncommon, but very destructive whenever found.

Aecidium verbenae Speg. Verbena rust. On leaves of hoary vervain (*Verbena stricta*). As yet not common or destructive.

USTILAGINEAE. THE SMUTS.

Ustilago panici-miliacei, (Pers.) Wint. On flower panicles of old witch grass (*Panicum capillare.*) This smut has been exceedingly plentiful this year, and very damaging to its host, often completely destroying the panicles, turning them into black masses of spores. The plants are generally very much distorted.

Entyloma physalidis, (Klachbr & Cke.) Wint. White smut of ground cherry. On leaves of *Physalis lanceolata*, forming roundish spots in the tissues of the leaves; white on the lower surface and brownish on the upper. Not uncommon and usually causing but little damage.

SPHAEROPSIDEAE.

Septoria asclepiadicola, E. & E. Leaf spot of milkweed. On swamp milkweed (*Asclepias incarnata*). Common and destructive.

Septoria atriplices, (West.) Fuckel. On leaves of goosefoot (*Chenopodium hybridum* and *C. albidum*). Very common and destructive.

Septoria erigerontis, B. & C. Leaf spot of horse weed (*Erigeron canadense*). Plentiful and destructive.

Septoria lactucicola, E. & M. Leaf spot of lettuce. On leaves of wild lettuce (*Lactuca sp*—.) Not uncommon and often rather injurious.

Septoria polygonorum, Desm. Leaf spot of smart weed. On leaves of lady's thumb (*Polygonum persicaria*) and smart weed (*P. pennsylvanica*). Forms conspicuous spots on the leaves. Very common and quite destructive.

Septoria rudbeckiæ, E. & Halsted. Leaf spot of cone flower. On leaves of tall cone flower [*Rudbeckia laciniata*]. Very plentiful and destructive. Forms large irregular purple-brown spots containing one or more whitish ones. The spots often run together and cover the entire surface of the leaf, causing it to wither and die.

HYPHOMYCETES.

Ovularia obliqua, [Cke.] Oud. Leaf spot of dock. On leaves of curled dock (*Rumex crispus*), and golden dock (*R. maritimus*). Forming brownish spots on the leaves. Common and destructive.

Ramularia arvensis, Sacc. On leaves of five finger or cinque foil (*Potentilla norvegica*). Very common and one of the most destructive members of the genus.

Cercospora avicularis, Wint. Leaf spot of knot weed. Very common on leaves of common knot weed or door yard grass, (*Polygonum aviculare & P. erectum*). It is very destructive, forming whitish spots on the leaves. Many patches of this weed were almost completely destroyed by the fungus this season.

Cercospora clavata, (Ger.) Peck. On leaves of swamp milkweed [*Asclepias incarnata*) and common milkweed [*A. syriaca*]. Forms brown patches on the under surface of the leaves. Common, sometimes becoming quite injurious.

Cercaspora ziziae, E. & E. On leaves of *Zizia cordata*. Quite common and injurious. Form conspicuous white spots with purple-brown borders.

III

FUNGI FOUND DAMAGING BOTH USEFUL PLANTS AND WEEDS.

PERONOSPORACEAE.

Peronospora effusa, [Grev.] Rabenh. Downy mildew of goosefoot and spinach. On leaves of goosefoot [*Chenopodium hybridum and C. album*], and spinach [*Spinacea oleracea*]. Plentiful. The fungus has been exceedingly destructive to all hosts this season. The spinach was completely ruined, much of it being killed before going to seed, and nearly all rendered unfit for use. Though this fungus is very useful in injuring the weeds it is one of the worst enemies that the spinach growers have to contend with here.

Peronospora parasitica, [Pers.] DeBary. This mildew has been common on all of our cruciferous weeds, as the mustard, and peppergrass. In some cases it has been very damaging to them. It was also troublesome to the radishes in the garden but did little damage to them.

PYRENOMYCETES. BLACK FUNGI.

Claviceps purpurea, [Fr.] Tul. Ergot Common on wheat grass (*Agropyrum glaucum*), quack grass (*Ag. repens*), and wild rye (*Elymus canadensis*). It has been especially destructive to the wheat grass and quack grass. Hardly an uninjured head of either species could be found on the college grounds. Here where these grasses are weeds the fungus is beneficial in its effects, but in some parts of the state, especially the West, where the wheat grass is one of the forage grasses, it is very injurious wherever it occurs.

It is thought by many to be very hurtful to stock that eat it in the hay The fungus has been known to occur on timothy and cultivated rye in many states and is usually more or less injurious in its effects.

UREDINEAE. THE RUSTS.

Puccinia menthae, Pers. Mint rust. II—III. On leaves of Mint (*Mentha sp*), in wild flower garden, and on common wild mint (*Mentha canadensis*), along streams. Very plentiful. This is one of our most destructive rusts. The plants in the garden were almost ruined by it this year.

Coleosporium solidaginis, (Schw.) Thuem Golden-rod rust. On leaves of tall golden-rod (*Solidago serotina*), in the flower garden and in the fields. Common. Frequently covers nearly every leaf on a plant with scattered masses of orange colored spores. Destructive

Coleosporium sonchi, (Pers.) Lev. On leaves of wild aster in both wild flower garden and field. Common. Not nearly so injurious as the preceding species.

SPHAEROPSIDEAE.

Septoria oenotherae, West. Leaf spot of evening primrose. Very plentiful on yellow evening primrose (*Oenothera biennis*], in wild flower garden and in the fields. It is very destructive forming large, irregular, pallid spots on the leaves.

HYPHOMYCETES.

Pericularia grisea, [Cke.] Sacc. On leaves of foxtail (*Setaria viridis* and *S. glauca*), millet (*Setaria italica*), and rice-cutgrass [*Leersia virginica*]. Common. It often proves very injurious to millet, causing the leaves to shrivel and dry up long before it is fit to cut for hay.

Cercospora rosicola, Pass. Rose leaf spot. On leaves of both wild and cultivated roses, forming roundish pallid spots bordered by purple. Not yet found to be very plentiful on cultivated roses here, but becomes very destructive to the wild rose.

SOUTH DAKOTA

AGRICULTURAL COLLEGE

AND

EXPERIMENT STATION

BROOKINGS, S. D.

BULLETIN NO 30

MARCH 1892.

Department of Entomology.

By Order of the Council,
WM. S. FROST, Secretary.

DUTCHER & BREED, BROOKINGS.

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The Bulletins of this Station will be sent free to all residents of the State who will apply for them.

Mail for the Station should be addressed to the Director, and that for any special department to the officer in charge.

THE NEW INSECTARY.

Recognizing the necessity of facilities for rearing insects in a situation where all external conditions could be controlled, as well as of a suitable place for keeping the collections and apparatus of the department, the board of trustees last year authorized the construction of a building for the entomological department. This was occupied about June 25. It is a structure 16x32 feet in size, with wing 12 feet square. In the main part is the general office and work room, 16 feet square, a well finished room, provided with desk, tables, balances, shelves for collections, &c. Here are kept a general collection of all orders of insects, chiefly collected in this locality; some economic collections, showing the transformations, work and parasites of some of the common injurious insects; samples of various insecticides, and a few bee supplies.

The rearing-room, or insectary proper, occupies the remainder of the main part of the building. It is an unfinished room with dirt floor, lighted by five large windows. It is as yet but partially fitted up, owing to the fact that the rearing season was almost past when we moved into the building last spring. Breeding cages and other devices for this line of work will be in operation this year.

The wing on the east side of the main building is devoted to bee-keeping and storage of machinery, &c. The bees are placed on a low shelf along the side of the room, the faces of the hives toward the outside. Horizontal slits through the wall, one immediately in front of each hive, give the bees egress. This arrangement is called a house apiary, and presents several advantages, in our circumstances. The hives are safe from violent winds and are in a very convenient place for working with them, as by nearly closing the door the room can be darkened until the bees will not fly in it.

PARASITES OF THE LARGE WILLOW SAW-FLY.

About the middle of May, 1891, an examination was made of 748 cocoons of *Cimbex americana*, the Large Willow Saw-fly, for the purpose of ascertaining the proportion that were parasitized. The results were as follows:

375 cocoons, or 50 per cent, contained healthy larvae or pupae; 229, or 31 per cent, contained cocoons of a large parasite, *Opheltes glaucopterus* Linn.; 25, or 3 per cent, contained several cocoons each of smaller hymenopterous parasites; 23, or 3 per cent, contained dipterous parasites; 96, or 13 per cent, contained larvae dead but not parasitized.

The subsequent rearing of these parasites furnished most of the data for the following notes.

Hymenopterous parasites. *Opheltes glaucopterus* Linn. As the above summary shows, this is by far the most important parasite, destroying about one-third of the whole number of saw-flies of the species under consideration. In the spring its presence is indicated by a slender black cocoon within that of the saw-fly, occupying the entire length and about half the diameter of the latter. The mature insect is $\frac{7}{8}$ inch long. The general color is orange red. The tip of the abdomen, from near the middle of the fourth segment, is black, as is also the thorax, except the scutellum and sometimes the disk. The wings are distinctly yellow, changing to brownish toward the apical and posterior border.

The insect has been observed here for three seasons, and is increasing in number with great rapidity. The fact that the damage by Cimbex in this state was decidedly less last year than for several years before, is probably explained by the presence of this parasite.

Cryptus nuncius Say. Of this species as many as eight or ten small white cocoons are found in a single Cimbex cocoon. For this reason we obtained a large number of specimens, though but a few Cimbex were affected.

As there seems to be some confusion of this species with *Cryptus extrematis* Cress., the original description of both are here reproduced:

Cryptus nuncius, Say (Complete Works, II, 693).

"Black; abdomen excepting the base and tip rufous.

"Inhabits Pennsylvania.

"Body black; palpi white, blackish at tip; antennae of the female with a long white annulus in the middle; thorax immaculate; two impressed lines; wings hyaline; nervures brown; stigma rather slender; second cubital rather large, pentagonal, the two angles on the radial nervure nearly rectangular; recurrent nervures almost rectilinear: tergum basal segment wholly or in part black; second, third and generally half of the fourth rufous or honey yellow; remaining segments black; oviduct nearly half the length of the abdomen; feet honey yellow; posterior pair of tibiae at tip and knees black; posterior tarsi pale yellowish.

"Length about two-fifths of an inch.

"I obtained many specimens from the larva of *Attacus promethea* Linn. several years ago."

Cryptus extrematis Cresson (Proc Ent. Soc Phil., III, 304).

"Black; antennae with a broad white annulus; legs and three basal segments of the abdomen rufous; large spot on the sixth and seventh segments, and the posterior tarsi, white; wings clear. Ovipositor nearly as long as the abdomen.

"Female. Black, shining, somewhat robust; head short and broad; antennae as long as the body, slender, black, the seventh to twelfth joints white; the third and fourth joints long, the third rather the longest, the fifth a little shorter than the fourth, and the sixth about half as long as the third Thorax finely punctured, the dorsal lines rather deep; scutellum sub-convex, polished; metathorax finely scabrous, opaque, its base smooth and shining, the elevated lines tolerably well defined, forming a large, more or less distinct sub-rhomboidal central area, lateral tubercles not well defined. Wings faintly tinged with fuscous, nervures and stigma blackish; pale at base, areolet large, subquadrate. Legs pale rufous, the posterior femora and tibiae at tips, and the base and apex of their tarsi blackish, rest of the tarsi white Abdomen rather stout, sub-ovate, polished, rufous or yellowish rufous; basal segment strongly arcuated, broad at tip; the fourth and following joints black, the sixth or seventh, or both, more or less white above; ovipositor about as long as the body, rufous, valves black. Length, 4 to 5½ lines; expanse of wings, 6 to 9½ lines.

"Male. Resembles the female, but much slenderer; the antennae is more or less yellowish or whitish beneath; the four anterior coxae are white as well as the posterior tarsi, except extreme tips; the abdomen much more elongated and subcylindric, the basal segment mostly all black, linear, with a projection on each side, behind the middle; the second, third and most of the fourth segments are rufous; the seventh and sometimes the sixth segment has a rounded white spot above. Length, 4½ lines; expanse of wings, 7 lines.

"Habitat, Mass. (Sanborn), Pa. (Auxer), Delaware (Dr. Wilson).

"This is closely allied to *C. nuncius* Say; but is at once distinguished from that species by having the white spots on the apex of the abdomen; otherwise they are similar."

A comparison of over eighty *nuncius* with over forty *extrematis* shows that the average size of the latter is decidedly greater, it is more slender, the ovipostor is distinctly longer in proportion to the total length, and the middle joints of the tarsi are always white or distinctly whitish; in *nuncius* females the hind tarsi are not even whitish, but yellowish red, but the males have the same white tarsi as in *extrematis*. In *nuncius* there is often a distinct trace of the white abdominal spots supposed to characterize the other species. In the males of *extrematis*, the antennae have a white annulus, though less conspicuous than in the females, and are also "more or less whitish or yellowish beneath;" in *nuncius* they have no white at all, but are uniformly black We have reared *nuncius* only from C*imbex americana* and *extrematis* only from *Platysamia cecropia*. *Extrematis* emerged as a mature insect June 12 to 18, and *nuncius* May 15 to 29.

Limneria ferrugineipes Ashmead. Of this species about 20 specimens were reared. They come from small inside cocoons, the same as the Cryptus The perfect insect is ¼ inch (6mm.) long, almost uniform black except the mouth and all the legs, which are brownish red. They emerged May 20 to 29.

Mesochorus melleus Cresson. A Cimbex cocoon sent from Egan, S. D., contained this species. Seven specimens were reared. It is a minute yellow insect, slightly more than ⅛ inch (3.3mm.) long, with eyes black and base of abdomen brown. Mr. Howard states that it is known as a secondary parasite, so it is probably to be recorded as an enemy to one of the above parasites, and a friend to the willow saw-fly: that is, as an injurious insect. They emerged May 20 to 29.

DIPTEROUS PARASITES (FLIES). *Sarcophaga cimbicis* Townsend. Two flies of this species were reared. It is an ordinary looking gray fly about the size, of the house-fly. The larvae are maggots, similar to those found in carrion. The two specimens we secured are now in the collection of Professor C. H. Tyler Townsend, of the New Mexico station. He considers them representatives of a new species for which he proposes the name above. The description is published in the Canadian Entomologist for May, 1892, page 126.

Phora cimbicis Aldrich MS.
Phora minuta Aldrich MS.
Phora setacea Aldrich MS.

Of the first of these species, three specimens were secured; of the second, one; of the third, five. All are very minute black flies. Not much can be ascertained regarding their structure unless a microscope be used. For this reason, no attempt will be made to describe them in a popular way. All three are new species, and the original descriptions, drawn up by Mr. Aldrich, will shortly appear in the Canadian Entomologist, probably in the June number.

FOOD HABITS OF THE STRIPED GOPHER.

The striped gopher (*Spermophilus tredecimlineatus*) is everywhere known in the northwest as a serious pest, on account of its fondness for sprouting seed-corn, and its habit of biting off stalks of wheat to bring the heads down within its reach. The damage done is so conspicuous that almost all farmers have joined in warfare against the little animal. Some offer a private bounty of one to five cents a head for all gophers killed on their own land. In not a few cases, county commissioners have offered a bounty, generally two cents, for every one killed in the county. Such measures as these reflect the general opinion as to the undesirability of gophers on a farm.

And yet, in spite of this, there is something to be said in their favor. Looking at the matter from a theoretical standpoint, they *may* assist the farmer by eating injurious insects and also the seeds and roots of weeds. To ascertain just what they actually do in this line is a matter of considerable difficulty. Although they are often comparatively tame they will not permit such a close approach as is necessary to settle this point by actual observation. The only alternative is to examine the contents of the stomach of gophers that have been killed. To correctly classify the small fragments thus found requires quite a high degree of special knowledge. It is therefore not to be wondered at that, while occasionally a person is found who has a theory that gophers have their good qualities, there is almost a total lack of definite knowledge on the subject.

Professor C. P. Gillette, now of the Colorado Agricultural College, conducted at Ames, Ia., while Entomologist of the Iowa Experiment Station, the only series of such examinations aside from our own, that we have learned of. He examined 22 stomachs, the gophers being killed at intervals, the earliest April 19, and the latest August 2. They were taken on various parts of the college farm, several being killed on the college campus, an area covered with sod, in which were many caterpillars of the sod web-worm and numerous cutworms. The summary and conclusions are as follows ;

"By combining the percentages above given and dividing by 22 we find that 46 per cent of the contents of these stomachs was insects. If we add together all the cut-worms and web-worms found and divide by 22 we get 13 as the average number. If we suppose that the amounts found in the stomachs represents, on an average, one-half the daily food, this would give 26 as the average number of worms consumed by a single squirrel each day from Apr. 19 to Aug. 2, and 2730 as the total number (consumed by one squirrel). These figures multiplied by the number of squirrels living upon a given piece of ground will give some idea of the amount of benefit derived from them. This, without saying anything of the large number of grasshoppers, wire-worms, and other noxious insects eaten, makes a very large credit account to be placed over against the debits charged to these squirrels. Although it would have been desirable to examine a larger number of stomachs, it seems fair from the above statement to draw the following conclusions :

1.—Insects certainly constitute a large proportion of the food of the striped squirrel.

2.—The insects which the squirrels feed on are almost exclusiveiy injurious species, chief among which seems to be cut-worms, web-worms and grass hoppers.

3.—As grass, clover, and other green stuff has been abundant wherever the squirrels were taken, and as their stomachs were often gorged with insects, that must have given them much trouble to catch, it would seem that they prefer the latter food.

4.—From the above, it seems certain that the squirrels must be a decided benefit to lawns, meadows and pastures.

5.—If the ground containing cut-worms, web-worms and wire-worms is to be turned over to corn, the more squirrels that can be harbored upon it up to planting time, the less wili the crop be damaged by these insects.

6.—The squirrels would be a most valuable adjunct to any cornfield after planting, if some method could be devised to prevent them from taking the corn."

The above observations are quoted at some length, in order to compare them with the results of our experiment. June 19 and 22, corn was well up, but the planted kernels were still in condition to invite the gophers. There were few ripe seeds of any kind, so that the stomach contents were generally classfied into insects, corn and "green stuff," the last being apparently grass and other plants, a mixture difficult to analyze and not of great importance from our standpoint. The corn was readily distinguishable, while the insects were usually represented by legs, antennae, elytra, and other hard parts, more or less fragmentary. In the case of cut-worms and other larvæ, the whole or a large piece of the skin was generally found, the soft parts having been crushed out. It was not possible, as a general thing to make out the species of the insect, but the genus or family is sufficient to indicate pretty well whether the species is injurious or not.

Nos. 1 to 7 were killed on the afternoon of June 19, between 1:15 and 4:30.

No. 1. In the road near the corner of pasture. Only grass and small grain in the immediate vicinity. Stomach quite full, mostly grain, a little green stuff, and remains of at least one beetle (probably carabid). Another gopher near this one was observed to pick grain out of horse manure in the road.

No. 2. Near No. 1. Stomach not very full, grain and grass; one beetle (Chrysomela).

No. 3. Near a little stream. Tall grass and weeds all around. A young gopher, $\frac{2}{3}$ grown; stomach half full of green stuff; remains of one beetle (Harpalus?)

No. 4. By an old straw stack; weeds, potatoes and pasture near by. Stomach very full, mostly grain and seeds, about $\frac{1}{3}$ bettles (carabid and perhaps chrysomelid.)

No. 5. Also killed by the straw stack Stomach full; more grass than No. 4; one beetle (carabid).

No. 6. Same place. Stomach full; mostly green stuff; several beetles, 3 pieces of skin of lepidopterous larvæ, of which two seemed to be cut-worms.

No. 7. Same place. Stomach full; grain, grass, 1 cricket, 2 beetles (chrysomelid and carabid.)

The next four gophers were killed June 22, between 9:15 A. M. and 1 P. M.

No. 8. At edge of grass plat, 10 rods from corn field. Cheeks full of corn. Stomach full, $\frac{2}{3}$ corn, rest insects; 1 beetle; 1 cricket (?), about 6 cut-worms.

No. 9. At edge of creek. Stomach nearly empty; one lepidopterous larva, not a cut-worm; one or two beetles (Chrysomela); the rest vegetable.

No. 10. Same place (40 rods from corn field). Stomach moderately full of corn; 1 beetle (carabid ?).

No. 11. Same place. Stomach full; mostly insects, numerous beetles (carabid and chrysomelid), one grass hopper, one larva, not cut-worm.

The remaining four were killed June 23, about noon.

No. 12. At edge of timothy field, near millet, 30 rods from corn. Stomach moderately full, half corn, a little grass, about

4 cut-worms, two or three chrysomelid and as many carabid beetles, one grass hopper.

No. 13. On campus, grass all around. Stomach moderately full; $\frac{1}{3}$ grass, the rest insects. About 8 lepidopterous larvæ of which one or more were cut-worms.

No. 14.—In raspberry patch. Stomach full, mostly corn and grain; one grasshopper; 3 cut-worms; 1 carabid beetle.

No. 15. In road, not a great distance from corn field. Stomach full;half-full, corn; 1 beetle; 3 or 4 lepidopterous larvæ, of which 2 were cut-worms

Summing up the insects, we have 19 or 20 cut-worms, 11 other lepidopterous larvæ, 3 grass hoppers, and 2 crickets, all of which may be set down as injurious. The number of beetles of all kinds could not be definitely ascertained, but was 30 to 35. None of them were species which are noted either for benefitting or injuring the farmer. Those marked carabid and Harpalus, belong to a family that are in general beneficial, while those marked chrysomelid and Chrysomela belong to the leaf-eaters, of which group many species are injurious. As the beetles found in the gophers' stomachs were of both classes, there is no great preponderance on either side.

As far as our observations go, they do not give the gopher as favorable a showing as Professor Gillette's did. This line of work will be continued this season, and examinations will be made of the stomachs of larger numbers.

Unless some method can be found to prevent gophers from digging up corn, it is not likely that most farmers will give them a chance to demonstrate their good qualities. Such a method, we are informed by several good authorities, is already in existence. It consists simply in dragging the ground smooth after planting, and then sprinkling shelled corn broadcast around the edges of the field. This treatment supplies the needs of the gophers and they do not find the planted corn.

APPLYING POISON TO POTATOES.

As the college farm has raised about twelve acres of potatoes a year for several years, the best manner of apply poison to them has been an important question. In the absence of any machine specially designed for low plants, the spraying was at first done by means of two tree spraying outfits (a barrel and a tank), loaded into a wagon and drawn down the rows. This method was soon discarded, as it required two or three men and a team to spray two rows. Next a common sprinkling-pot was tried, with far better results. An operator could cover more ground, and, in the case of large vines at least, could give a more thorough application than from the wagon with the sprayers. Still the team could not be entirely dispensed with, as barrels of water must be drawn, and it was found that the outlay for labor was still large. A machine was needed which would cover more rows at once and dispense with part of the help. Such a machine was designed, constructed, and successfully used last season. It is in a degree a modification of the common street sprinkler, the delivery being arranged so that the liquid falls only on the rows. The hind wheels and axle of a wagon were taken to begin with; a tongue was added,and a platform for a barrel was built over the axle; underneath the barrel a connection was made with a long transverse delivery pipe, which was located behind the wheels, resting on iron supports running back from the corners of the platform. This pipe carried three backward. directed nozzles, at the same distance apart as the rows of potatoes (3½ ft.). Figure 1 shows the machine from above, with the barrel removed and its place indicated by a dotted circle. The sprinklers are the size used on *small* sprinkling pots, and were obtained at a hardware store. Aside from the wheels and axle, the entire cost of material was about five dollars. The frame was made quite long and the plan was to have two barrels,

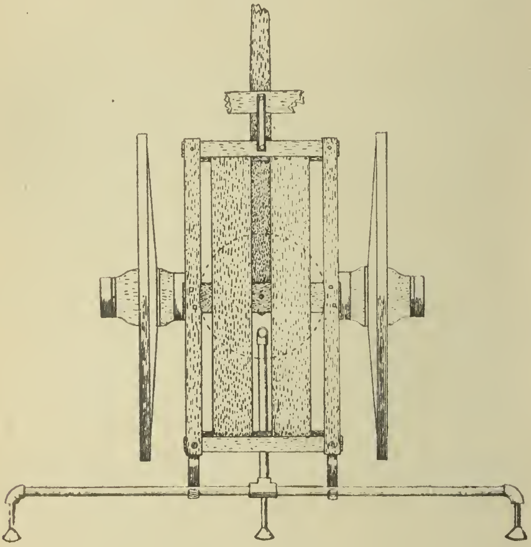


FIGURE 1.

connected by a pipe near the bottom; but this was not afterward carried out.

In order to do good work with the machine, it is highly important that the rows of potatoes should be a uniform distance apart. Any deviation in this respect will result in uneven sprinkling. The water used should contain no sticks, dirt, or any other material that will clog the nozzles. The pipes should be so arranged that when the tongue is raised the nozzles will be at a height of seventeen or eighteen inches from the ground. To stop the flow while going to the field and while turning at the end of the rows a rather primitive device was used, consisting merely of a stick wrapped with rags at the end, which was thrust into the hole in the bottom of the barrel. The stick was a little longer than the barrel, so that it projected at the top. London purple was the poison used, and no mixing was needed except at the time of refilling, as it took only a short time to empty the barrel. One pound of poison to a hundred gallons of water is a good proportion. In working at a distance from the water supply, it would be much better to use two barrels on the machine and thus avoid part of the travel back and forth.

BEE-KEEPING.

Five swarms of bees were received May 28, 1891, from a bee-keeper in Rochester, Minn. They came by express and stood the journey well. In common with all swarms of the region from which they came, these were very weak in number, and had no honey, but had been fed for some time previous to shipment. They were in old hives, the combs being mostly crooked so that they could not readily be taken out for examination.

Our object in getting the bees was to find out whether with ordinary care they would do well in a strictly prairie region. Our nearest native timber is over four miles away.

The weather being favorable, the bees went to work very soon after arrival. They were noticed about the flower beds and shrubbery in large numbers. In their season, raspberries, strawberries, and other small-fruit flowers were much visited. Among the experimental plats were three or four of the common clovers, $\frac{1}{8}$ acre of each. These were located about a quarter of a mile from the hives. When the plants began to blossom, about June 10, the bees began to store honey at a rapid rate, and kept it up until the plats were mowed on July 20. Roughly estimated, three-fourths of the honey yield of the season was obtained at this time. There was no buckwheat honey, as the grain was killed by frost just when it was fairly coming into bloom.

It is a noticeable and discouraging fact that, in reviewing the summer's observations, we find that the native wild flowers were but very little sought by the bees. Milk-weed (*Asclepias cornuti*) a few little yellow crowfoots (*Ranunculus repens*, *fascicularis*, and *hispidis*), and the Indian currant (*Symphoricarpus occidentalis*) were the only ones that seemed attractive, and these could have furnished only a small amount of honey, as they were not very numerous and, being low ground plants, the nearest were about a mile from the bee-hives. The common wild mustard (*Brassica nigra* and *sinapastrum*), which had been regarded as a very hopeful honey plant, seemed to be quite untouched, as not a single bee was observed to visit it in the whole season.

The following record of weights was made:

	Wt. on arrival.	Wt. June 27.	Wt. June 30.
Hive No. 1	32½		62
" " 2	33		56
" " 3	34½	58	
" " 4	37½	49	
" " 5	29	44	

No. 4 swarmed just before the second weighing. Considering the poor condition of the swarms when received, the above showing was thought very favorable. Sections were put in on the first week in July. Some swarms did considerable work in them. Altogether, about 80 pounds of honey was taken off, of which about 60 was of fine quality, chiefly from clover.

The first new swarm issued June 27, others came out July 1, 8, 14, and 26. Although these were all rather late, the fine work done by the bees up to July 20 led us to think they might be able to maintain themselves. The new swarms were given frames full of foundation. All went to work and for a time seemed prosperous. Aug. 28, having just returned from a short absence, the assistant discovered that two of the hives formerly occupied by young swarms had no bees in. Each contained ten to fifteen pounds of honey, and considerable pollen, but there was no sign of brood, though one had a queen-cell partly constructed. The appearance indicated that the queens had been infertile, and so the swarms had dwindled away by the natural death of the older bees. The same fate befell a third new swarm later in the fall. In this case the swarm ran down to about a hundred bees, which were chilled on a cold night in November. So only seven swarms were left to winter. These were left on the summer stands (see article "The New Insectary" for description) until Dec. 1, but the slits in the walls were closed when the cold winds began to blow, so they were well protected. On the above date they were moved into the green-house cellar, which was the only available place to winter them. Here they were left undisturbed until Jan. 20, when it was found that one new swarm had starved to death, and the other was almost out of honey. The old swarms with one exception, were also found to have but little honey in store. All needing it were fed by inserting frames taken from the hives left vacant in the fall. This feeding was repeated at intervals until spring.

Commencing about the middle of February was a warm spell which caused the cellar to become damp. This proved bad for the bees The old hives were so constructed that thorough ventilation was very difficult. Dysentery broke out and killed many bees. On one or two occasions the interval between feedings was a little too long. From all these causes, we have at present only one swarm. This one was the heaviest at the beginning of winter and was not fed at all. It is now in good condition.

To speculate on what might have happened had circumstances and treatment been different is not very profitable work. We have sought to present the facts. It seems safe to conclude that bee-keeping under our circumstances is a business of very doubtful profit. Bees can store honey only during summer months, as a general thing. During at least eight months they must live on what they have accumulated. Without the help of clover it seems as if our bees could not possibly have made honey enough to have wintered themselves, even under the most favorable circumstances; and yet clover field are very rare in this section of the state.

SOAPSUDS FOR CABBAGE LICE.

Probably none of our common pests is more difficult to reach than the cabbage louse. The colonies are always on the under side of the leaves and frequently work their way into the outer part of the head where the leaves are close together. Besides this, the lice secrete a floury substance, which makes them shed water to perfection.

Some time ago we undertook a line of experiments against them, using kerosene emulsion of different strengths The result was that a weak emulsion had little or no effect, while a stronger one thoroughly applied killed the lice, but at the same time ruined the cabbage by giving it a flavor of kerosene which remained when it was brought upon the table.

After some further study, a trial was made of strong soapsuds alone, and this proved highly efficacious, giving much better satisfaction than any other remedy for the pest ever used at the station. While water alone will roll off from the insects without wetting them, the addition of soap gives a compound that penetrates readily. The chief drawback is that many of the lice are in such positions that they can only be reached by the utmost thoroughness of application. On this account a good deal of time is required. Some kind of a spraying pump is indispensable for this work. It is also important to attack the lice early in their ravages, as there are then comparatively few to deal with, and the plants are not much weakened.

KEROSENE EMULSION FOR LICE ON STOCK.

This remedy is likely to be generally adopted as soon as its merits and the best methods of preparation and application are known. An experiment at the college farm this spring was intended to throw light on these points. We prepared our emulsion after what is known as the Cook formula, which is as follows: In two quarts of boiling water dissolve one fourth pound of good hard soap, remove from the fire, immediately add one pint of kerosene and agitate the mixture violently by running it through a spraying pump with a small nozzle back into the original vessel. In three to five minutes the liquid becomes creamy, and if perfectly made no free kerosene will rise to the surface when it is allowed to stand a few minutes. This free kerosene, if present, is a disadvantage, as when applied to stock it removes the hair, and when applied to plants it kills all the foliage it comes in contact with. In our experiment, owing probably to the fact that the pump used was out of order and would not stand a high pressure, a little kerosene separated and rose to the top. After waiting five or ten minutes until it had all risen, we drew out the perfect emulsion from beneath the surface by means of the pump and used it in our work.

Of course the quantity of the respective ingredients mentioned in the formula may be multiplied by any number, to make enough emulsion for the work proposed, or to have a supply left on hand for future use. The proportions given are such that one fifth, or 20 per cent, of the mixture by volume is kerosene (disregarding the soap, which adds but little to the volume). Before using, this must be greatly diluted. In the case under consideration, three parts of water were added to one of emulsion, thus bringing the proportion of kerosene down to 5 per cent. Even this was tenacious and stringy when quite cold, and we used it a little warm. It was applied to stock by means of a sponge, and was found to be instant death to the lice. It did not injure the hair at all. A quart is more than sufficient to treat a horse, as it penetrates to the skin very rapidly. Thus the cost of material sinks about out of sight, being about 3-16 of a cent for a horse, and probably not over 1-16 for a calf. Almost any spraying pump will make the emulsion.

In this connection it is worth while to urge the use of kerosene emulsion for other insects. No more economical or effective way can be devised for renovating an old hen-house than to give the whole inside a thorough spraying with 5 per cent emulsion. The machine will dash it into the cracks so as to reach all vermin.

For nearly all soft-bodied insects that attack vegetation (such as caterpillars and saw-fly larvae, as well as plant lice), kerosene emulsion is a sovereign remedy. In some cases it must be used stronger than 5 per cent, perhaps as strong as 8 per cent, but it is well to try this strength on a few leaves and let them dry before making a general application. The newest leaves should be chosen, as they are more liable to be injured. If no discoloration of these is found after they are dry, it is safe to proceed; if they are blackened and wilted, the plant will not stand such strong emulsion.

KEROSENE EMULSION FOR SHEEP SCAB.

We have recently been enabled to test this remedy for sheep scab, which, as is well known, is produced by the work of a small mite in the skin. These mites differ from lice in many characteristics of structure and habits. They are much more difficult to kill, as is illustrated by the fact that two specimens placed in strong alcohol (93 per cent) continued to exhibit signs of life for nine and fourteen minutes respectively. Under such conditions, lice would live but a few seconds.

Twenty gallons of soft water was heated to the boiling point, ten pounds of hard soap (we used Kirk's "Coronet," a cheap brand) was dissolved in it, and five gallons of kerosene added, the mixture was then pumped briskly through a cheap spraying pump back into the vessel. The violent agitation thus produced caused the materials to emulsify in about five minutes. After allowing the emulsion to stand two or three minutes a little free kerosene rose to the top and was skimmed off with a shovel, perhaps to the extent of a pint in all. We then diluted the emulsion by adding forty-five gallons of water, so that it contained about 7 per cent of kerosene. We were careful not to dip any sheep while free oil was floating on the surface.

In all seven sheep were dipped during the progress of the experiment. These were affected by the scab in all degrees, some but very little and others so badly as to be almost entirely naked from its effects, and barely able to walk. They also varied greatly as to the amount of wool they carried. One was a yearling that had never been sheared and had a very heavy fleece; another had been sheared about six weeks; others, just previous to dipping; while two, although not sheared this season, were almost naked from scab, as stated. These last ones were dipped just as the experimenter was about to return to Brookings and it was therefore impossible to study the effect upon them. Although the weather was rainy and the sheep dried off very slowly, not the slightest injury to skin or wool was shown. On the contrary both seemed to be improved. The dip was used about blood-warm, and it penetrated the scab to a very surprising degree. Except in the very worst cases, it seemed unnecessary to scrub the scabs with a brush (as is recommended with other dips) because they were perfectly saturated in an instant without it. The yellow deposit which clings to scabby wool close to the skin was almost wholly dissolved and washed out.

On making a tolerably close examination of the sheep 24 hours later, using a hand lens, no live mites were found, and but very few dead ones, even in situations where they were known to be living and abundant before dipping. Two days after dipping, a sheep was selected which we had examined several times previously and knew to have been badly infested; this sheep was laid on a table in a good light and tied down, the scabby places were clipped bare and a careful examination of over an hour's duration was made, with the same hand lens used all through the work. The result was that one single live mite was found and quite a large number of dead ones. It is a singular fact that the whole number found was not more than one-tenth of what were alive on the same area two days before. Perhaps part were washed out in dipping, but the matter is not well explained at present.

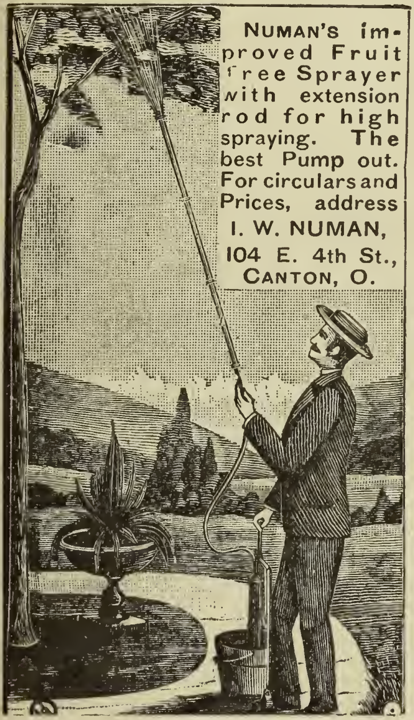
It was the opinion of several sheep-men who saw the wool after dipping that the cleansing properties of the emulsion would make it a very valuable dip, even where sheep were free from parasites. The wool certainly came out looking remarkably clean and soft Further experiments are now arranged for to ascertain just what effect upon the value of the wool is produced by this dip.

This finding of a single live mite upon the dipped sheep we do not regard as surprising, considering the thoroughness of our search. It is customary to dip twice or three times for scab with any remedy.

The cost of this dip will depend entirely upon the price of soap and kerosene. At the rate of five cents a pound for soap and eighteen cents a gallon for kerosene, the emulsion costs two cents a gallon. We do not figure the cost of the pump, for a two-dollar spraying pump ought to be regarded as a household necessity, and will pay for itself many times in applying poisons to plants and in other uses.

A CHEAP SPRAYING PUMP.

In order to carry out the recommendations of this bulletin, it is necessary to use some kind of a spraying machine. One that has been used by us for a full season, and has proved very useful and convenient, is illustrated in figure 2. While there are others as good, no doubt, we have found this one well worth the price The manufacturer sells it for $2.00. He also offers 2 for $3.00, 6 for $7.00 and 12 for $12.00, so a club order will be a great advantage.



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This machine will not produce so fine a spray as one costing twelve or fifteen dollars. It is therefore somewhat less economical of the material used in spraying, but considering the difference in first cost of the machines and the low cost of insecticides, this is not a serious point to those who work on a small scale.

GENERAL RECOMMENDATIONS.

The following recommendations, based almost entirely upon our own experience, are designed to present, in a form convenient for reference, the best remedies for some of our commonest insect pests.

Willow saw-fly.—Spray the trees with London purple or

Paris green in water, one pound to 100 gallons. This is a very easy insect to kill and there is no reason why its ravages should continue.

Cottonwood leaf-beetle.—Spray as for the willow saw-fly. Thorough work will succeed.

Plant lice.—Spray with five per cent kerosene emulsion or with strong soap-suds.

Cut-worms.—If possible, have garden spots and cornfields thoroughly burned off the fall before. Protect young garden plants until June 20 by means of old fruit cans set around them. Any land kept *clean* all the fall will probably be free from cut-worms next year.

Cecropia moth (*Large Box-elder worm*)—Collect all the cocoons from the trees during the winter, or before June 1, and destroy all except those containing groups of small white cocoons of parasites. In summer pick off by hand or spray as above.

Tent caterpillar.—Examine trees before they leave out in the spring, and remove the eggs, which occur in bunches encircling the twigs. Spray as above if unsuccessful in collecting the eggs.

Ash borer.—At the first appearance of "sawdust" on the surface, cut through bark with a knife and kill the borer. To prevent the moths from laying their eggs, examine the trees frequently in June and the last of May to find the holes in which they are preparing to emerge. Each hole is covered by a thin scale of bark, of lighter color than that surrounding it, and readily yielding to the pressure of the finger. Simply thrust the end of a wire into the hole and crush the insect inside.

Potato beetle.—Sprinkle with London purple or Paris green in water, as above mentioned.

We are glad to be consulted at any time in regard to insect depredations, and will furnish any information possible in regard to life histories, remedies, spraying machines, etc. All inquiries in regard to insects should be accompanied by specimens, which should be sent in a tight tin or wooden box. Postage is one cent an ounce.

We are under obligations to the Division of Entomology at Washington for determining the names of part of the saw-fly parasites; also to Professor A. J. Cook, of Michigan, for furnishing description of *Cryptus extrematis*.

I. H. Orcutt, Entomologist.
J. M. Aldrich, Assistant.

SOUTH DAKOTA

AGRICULTURAL COLLEGE

AND

EXPERIMENT STATION

BROOKINGS, S. D.

BULLETIN NO 31

MAY 1892.

Department of Meteorology.

By Order of the Council,
WM. S. FROST, Secretary.

DUTCHER & BREED, BROOKINGS

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The Bulletins of this Station will be sent free to all residents of the State who will apply for them.

Mail for the Station should be addressed to the Director, and that for any special department to the officer in charge.

METEOROLOGY.

At the close of the year 1888 this Experiment Satation published a bulletin of all the meteorological statistics gathered up to that time, but covering a period of only about eight months. It is now thought best to publish in tabular form all the meteorological statistics gathered from the beginning of observations down to the close of the year 1891. It is believed that a study of these tables of weather statistics will be of interest, as the period covered includes one year of short crops and one of very good ones.

It is the purpose to make more of the meteorological work of the Station hereafter.

TABLE I.

	Temperature. (Degees F.)			Barometer. (Inches.)			Rainfall.		Winds, No. of days in each direction.								Prevailing Wind.
1888	Max.	Min.	Av.	Max.	Min.	Av.	In.	Days.	N	NE	E	SE	S	SW	W	NW	
May (17-31)	73	35	55	28.37	27·90	28.16	2.61	9	...	...	...	...	...	...	...	...	......
June	95	58	67	28.46	27.78	28.18	0.71	11	..	...	...	...	...	...	...	...	......
July	101	42	70	28.64	28.08	28.36	1.61	9	3	0	4	2	12	1	1	2	S
Aug.	94	40	62	28.78	28.12	28.40	3.21	9	3	2	0	2	5	3	0	2	S
Sept.	93	23	57	28.67	27.98	28.41	0.56	4	4	0	1	1	4	7	2	3	SW
Oct.	82	21	43	28.55	27.82	28.24	0.62	5	5	1	1	3	4	3	2	8	NW
Nov.	67	2	30	28.77	27.96	28.34	0.00	0	5	2	0	3	5	0	0	2	S
Dec.	58	5	25	28.65	27.81	28.33	0.05	1	7	0	0	0	9	1	1	3	S

The last half of April and the first half of May were very rainy. It is estimated that during that time six inches of water fell.

First killing frost, Sept. 12. September frosts also on the 25th, 29th, and 30th.

Number of days it did not thaw in the shade, November, 4, December, 12.

No. of days mercury went below zero, 4; Dec. 28th being the first time.

TABLE II.

1889.	Temperature.			Barometer,			Rainfall,		Wind. No. of days in each direction.								Prev. Wind.
	Max	Min.	Av.	Max.	Min.	Av.	In.	Days	N.	NE	E	SE	S	SW	W	NW	
January	44	24	14	28.58	27.61	28.35	0.86	4	2	0	0	1	3	0	0	8	NW
February	43	-29	12	28 96	27.67	28.34	1.20	5	0	2	0	1	4	0	0	3	S
March	68	4	23	28.62	27.96	28.38	0.16	1	1	1	0	1	3	0	0	9	NW
April	83	12	48	28 55	27.93	28.33	1.03	11	10	1	2	0	11	1	0	1	S
May	91	20	54	28.68	27.44	28.28	1.93	9	10	0	1	1	7	0	0	0	N
June	94	36	64	28.69	28.10	28.35	1.49	10	8	1	0	0	9	0	0	1	S
July	98	37	70	28.58	28.02	28.31	2.92	8	7	0	0	1	10	0	0	1	S
August	97	42	70	28.67	28.06	28.33	0.72	3	4	0	0	0	9	0	1	0	S
September	89	30	55	28.62	27.88	28.34	2.70	4	6	0	0	0	5	0	1	1	N
October	76	24	44	28.75	28.26	28..43	0.01	1	10	0	0	0	6	0	0	0	N
November	58	-6	23	28.71	27.93	28.39	0.00	0	10	0	0	1	8	0	0	0	N
December	58	-21	27	28.46	27.74	28.22	0.93	3	6	1	1	3	13	1	1	4	S
Year	94	-29	43	28.96	27.41	28.34	13.95	59	74	6	4	9	88	2	3	28	S

January 25th, under the influence of a strong northwester the thermometer fell 30 degrees in eight and a half hours.

February 23d the barometer reached *28.96, the highest point known here, remaining there nearly 24 hours, the attached thermometer standing at—16,—24,—2 at the three observations taken during that time. No wind. Elevation of Station above sea level 1690 feet.

First frost Sept. 15th. Frosts also the 19th and 28th.

No. of days the thermometer fell below zero: January, 13; February, 15; November, 3; December, 4. Total, 35.

No. of days it did not thaw in the shade: January, 19; February, 20; March, 5; November, 6; December, 8. Total, 58.

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*Not corrected for elevation above sea level.

TABLE III.

1890.	Temperature.			Barometer.			Rainfall.		Winds, No. of days in each direction.								Prev. Wind.
	Max.	Min.	Av.	Max.	Min.	Av.	In.	Days.	N	NE	E	SE	S	SW	W	NW	
January	44	–28	5.0	......	......	......	0.65	5	14	0	1	1	14	0	0	2	N
February	48	–35	14	28.77	27.90	28.33	0.20	1	14	0	0	0	12	0	0	2	N
March	54	–28	20	28.90	27.78	28.40	0.56	3	10	1	0	0	16	0	0	0	S
April	84	10	48	28.75	27.89	28.35	0.79	4	6	4	0	1	9	2	0	0	S
May	90	23	52	28.54	27.80	28.20	3.33	11	8	8	0	2	5	2	1	2	NE
June	91	39	67	28.61	27.76	28.28	7.91	14	2	0	2	3	15	1	1	4	S
July	95	41	71	28.55	27.94	28.32	1.54	5	8	1	1	9	9	1	0	1	S
August	99	35	65	28.61	28.05	28.34	2.07	4	8	1	2	3	12	1	1	2	S
September	91	25	58	28.71	27.57	28.32	0.45	4	8	1	1	4	11	1	1	1	S
October	75	21	44	28.72	27.78	28.24	0.31	4	3	3	0	7	4	5	1	6	SE
November	68	0	29	28.85	27.86	28.39	0.30	1	11	1	0	1	14	0	0	3	S
December	56	–20	21	28.81	28.00	28.39	0.80	2	6	0	1	4	13	1	3	3	S
Year	99	–35	43	28.90	27.57	28.29	18.86	58	98	20	8	35	134	14	8	26	S

Barometer observations recommenced the 14th of February.

There was a slight fall of snow, from the northeast, May 4th.

The month of June gave us the greatest rainfall of any month in the whole period. Some grain fields in this vicinity were badly rusted.

A very hot wind August 7th.

First frost Sept. 12th. Frosts also the 16th, 23d, and 27th.

First snow Nov. 8th, 3 inches.

Number of days below zero: January, 19; February, 10; March, 5; November, none; December, 4. Total, 38.

Number of days it did not thaw in the shade: January, 17; February, 15; March, 12; November, 4; December, 27. Total, 75.

TABLE IV.

1891.	Temperature			Barometer.			Rainfall.		Winds, No of days in each direction.								Pr v. Wind.
	Max.	Min	Av.	Max	Min.	Av.	In.	Days.	N	NE	E	SE	S	SW	W	NW	
January	52	-10	21	28.80	27.92	28.37	.10	1	13	1	0	1	13	1	1	1	S
February	48	-28	7	28.96	27.96	28.35	1.00	3	10	0	0	2	9	1	0	7	N
March	50	-24	18	28.71	27.80	28.36	0.60	2	12	1	3	0	13	0	0	2	S
April	88	11	44	28.70	27.85	28.35	2.23	8	4	1	1	4	11	5	1	3	S
May	93	30	56	28.82	27.93	28.37	0.84	4	5	6	2	4	7	5	0	2	S
June	89	38	64	28.59	27.91	28.23	4.09	10	0	8	0	7	6	2	0	5	NE
July	88	39	70	28.68	28.10	28.32	2.01	6	0	9	0	8	4	5	1	4	NE
August	100	30	66	28.61	28.12	28.32	1.38	7	2	7	0	7	4	4	1	6	NE
September	98	24	65	28.59	27.99	28.31	0.48	5	0	5	0	12	5	5	0	3	SE
October	80	20	45	28.82	28.00	28.35	1.07	2	4	2	0	8	5	2	4	6	SE
November	62	-29	26	28.77	27.78	28.04	0.25	4	2	2	0	7	4	2	0	11	NW
December	52	-21	25	28.81	27.59	28.13	2.12	6	1	1	0	4	9	5	1	9	S
Year	100	-29	42	28.96	27.59	28.29	16.17	58	53	43	6	61	90	37	9	59	S

A killing frost August 23d. Light frost September 3rd, and a heavy one September 29th. It will be noticed that the average temperature for September was but one degree lower than for August.

Number of days below zero: January, 4; February, 18; March, 9; November, 7; December; 4. Total, 42.

Number of days it did not thaw in the shade: January, 14; February, 17; March, 17; November, 10; December, 7. Total, 65.

TABLE V,

Showing monthly statistics from May, 1888, to December, 1891, inclusive.

Month.	Temperature			Barometer			Precipitation average.				Prev. wind.
	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min	Av.	Days.	
January	52	-28	13	28.80	27.61	28.36	.86	.10	.52	3	S
February	48	-35	11	28.96	27.67	28.34	1.20	.20	.80	3	S
March	68	-24	23	28.90	27.78	28.38	.60	.16	.44	2	S
April	88	10	47	28.75	27.85	28.34	2.23	.79	1.35	8	S
May	93	20	54	28.82	27.44	28.28	3.33	.84	2.03	8	N
June	95	36	65	28.69	27.76	28.28	7.91	.71	3.55	11	S
July	101	41	71	28.68	27.94	28.26	2.82	1.54	2.00	7	S
August	100	31	66	28.78	28.05	28.35	3.21	.72	1.85	6	S
September	98	23	59	28.71	27.57	28.35	2.70	.45	1.05	4	S
October	82	20	45	28.82	27.78	28.32	1.07	.01	.50	3	N
November	68	-29	28	28.85	27.78	28.29	.30	.00	.14	1	S
December	58	-21	25	28.81	27.59	28.27	2.12	.05	.97	2	S

The minimum precipitation for June occurred in 1888. The rainfall for the two months preceding was about nine inches. See table I.

The average temperature shows February to have been the coldest month and July the warmest.

Statistics for the years 1889, 1890 and 1891. Temperature: Max. 101; Min. –35; Av. 43. Barometer: Max. 28.96; Min. 27.44; Av. 28.30. Rainfall: Total 48.88 in.; 175 days. Wind, No. of days in each direction: N. 407; S. 473. E. 18; W. 20.

Average annual precipitation per year for three years, 16.29 inches.

Average precipitation per day (175 days), 0.28 inches.

TABLE VI,

Giving statistics for the growing months, April, May, June, July, August, September, for each of the years, 1889, 1890, 1891.

Year.	Rainfall.	Days.	Av. pp. per rainy day.	Per cent of the year's rainfall.	Wind No. of days in each direction.								Prev. wind.
					N	NE	E	SE	S	SW	W	NW	
1889	10.69	45	.24	77	45	2	3	2	51	1	2	4	S
1890	16.09	42	.38	85	40	15	6	22	61	8	4	10	S
1891	11.03	40	.28	68	11	36	3	42	37	26	3	23	SE
Averages ..	12.60	42	.30	77	32	18	4	22	50	12	3	12	S

This table shows that the most of our rainfall comes when it is most needed.

TABLE VII,

Giving statistics for January, February, March, October, November, and December, for the years, 1889, 1890, and 1891.

Year.	Rainfall.	Days.	Av. pp. per stormy day.	Per cent of the year's rainfall	Wind No. of days in each direction.								Prev. wind
					N	NE	E	SE	S	SW	W	NW	
1889	3.16	14	.23	23	29	4	1	7	37	1	1	24	S
1890	2.77	16	.17	15	58	6	2	13	73	6	4	16	S
1891	5.14	18	.28	32	47	7	3	22	53	11	6	36	S
Averages ..	3.69	16	.23	23	45	6	2	14	54	6	4	25	S

TABLE VIII,

Presenting, for the purpose of comparison, the rainfall for the months of April, May, June, July, and August, in 1888, 1889, 1890, and 1891.

Year.	April.	May.	June.	July.	August.	Total for five months.
1888	3.00	5.61	0.71	1.61	3.21	14.14
1889	1.03	1.93	1.49	2.92	0.72	8.09
1890	0.79	3.33	7.91	1.54	2.07	15.64
1891	2.23	0 84	4.09	2.01	1.38	10.55

*The month of April and the first half of May estimated.

SOUTH DAKOTA

AGRICULTURAL COLLEGE

AND

EXPERIMENT STATION

BROOKINGS, S. D.

BULLETIN NO. 32.

DECEMBER 1892.

Department of Forestry and Horticulture.

FORESTRY.

DUTCHER, BREED & STORGAARD, BROOKINGS.

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The Bulletins of this Station will be sent free to all citizens of the State who will apply for them.

All letters and other mail matter for the Station should be addressed to the Experiment Station.

FORESTRY.

J. C. WHITTEN.

During the season of 1892 no new plantings have been added to the forest plats. The season has, as a whole, been favorable to tree growth, though so wet as to prevent the successful extermination of weeds. During the early part of the growing season, copious rains greatly hindered work with the cultivator, and also kept the, ground so cold that weed growth did not begin in earnest until the latter part of June. About this time the soil became dry enough to be worked to better advantage, and a vigorous use of the cultivator was continued until July 7th, when cultivation ceased, in order to allow a thorough ripening of the new wood, as well as to allow the weed growth to cover the soil for holding the snows of the coming winter. Weed growth continued very late, so that clipping with a scythe became necessary, in some plats, where too great a tendency to ripen foul seed was noticed. This has been the only season in the history of the forest tree plantations at this Station, that has afforded opportunity to note the comparative effects upon different varieties of copious rains throughout the entire growing season. This adds features of interest that have not before been noted. Heretofore observations have been made principally with a view to determining what trees will quickly form leaf canopy, and thus prevent weed growth. Some of the plats have already reached that stage and will no longer admit of cultivation.

The accompanying diagram represents the entire forest plantation, with the exception of a seedling plat, and gives the varieties of trees in each plat. Plats 1 to 10 were planted in 1889; plats 11 to 22 in 1890 and plats 23 to 30 in 1891.

SOUTH,

ROAD.—1 rod wide.

8 Rods.

10 Rods

17A	16	14	12	10	8	6	4	2
Populus certinensis	Silver Maple	Green Ash	Box Elder	Black Cherry Yellow Birch White Birch White Elm White Ash	Soft Maple Cottonwood Scotch Pine White Ash White Birch	Populus certinensis White Elm White Ash	Box Elders Yellow Birch White Pine	Pop. (4 var.) Bl'k Walnut White " " Birch " Elm " Ash Box Elders

ROAD.

17B	15	13	11	9	7	5	3	1
Populus certinensis	White Elm	Green Ash Seed.	Box Elder Seed.	Bl'k Walnut Cherry Box Elder Wh't Walnut P. certinensis White Elm S'lix fragilis White Birch Whiite Ash White Pine	Box Elder Wh'te Ash Bl'ck Walnut Black Wild Cherry White Elm Populus 2 varietes	White Elm Box Elder White Oak Bl'ck Walnut	European Larch Box Elder	Black Hills Spruce Box Elder Cottonwood Populus certinensis Scotch Pine

ROAD.

26A	25	24	23	22	21	20	19	18
Maple Box Elder Walnut Hickory Elm Ash Cherry	Box Elder Maple Walnut Cherry Elm Ash	Box Elder White Spruce	Box Elder Cherry Ash	Populus certinensis	Green Ash	White Elm	Populus certinensis Soft Maple	Silver Maple Hickory

ROAD.

26B	27	28	29	30
Maple Box Elder Walnut Hickory Elm Ash Cherry	Maple Box Elder Elm Ash Cherry Bl'ck Walnut Butternut	Box Elder Elm Cherry Butternut Hickory P. certinensis	Elm Ash Cherry Spruce Hickory Butternut Box Elder	Elm Ash Cherry Spruce

ROAD.

Variety.	Total Growth in Inches.											
	1889.			1890.			1891.			1892.		
	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
Populus pyramidalis	23	10	16	40	18	36	43	16	35	....	....	....
Populus nolester	80	5	18½	38	18	35	46	20	37½	....	....	....
Black Walnut	7½	1½	4¼	9	3	6	20	6	18	40	3	11
White Walnut	9¼	1¼	6¼	....	....	....	....	....	....	....	....	....
Yellow Birch	10	3	6	30	7	20¾	36	9	21	60	22	39
White Oak	5	1	1⅜	9	2	5½	13	7	10	22	4	8
White Birch	7¾	2½	5¼	20	12	16	40	10	23	48	17	30
White Elm	24	3	9½	42	10	22¾	46	15	32	62	19	30
Black Wild Cherry	12	4	8	26	6	16	32	20	28¼	40	23	30
Soft Maple	12¼	4	8⅝	35	16	22½	45	26	34¼	40	20	33
Salix frigilis	8½	8	15¼	30	18	24	40	22	29¾	54	22	32
Scotch Pine	7¾	2¼	4¾	9	2	5	16	2	4	25	6	14
Larch	7½	2⅜	5	14	8	11⅛	16	5	11½	37	15	25
Black Hills Spruce	....	....	....	....	....	....	....	....	....	6	1	3¼
White Pine	7½	½	4½	8	1	4½	....	....	....	....	....	....
Populus certinensis	39	9	25⅛	40	14	37	34	10	24¼	46	23	35
Box Elder, 1 year old*	32	3¼	10¾	38	10	28¾	39	22	32	31	13	24
Box Elder, 2 years old*	34	5½	16	45	20	37½	51	24	38½	62	45	30
Cottonwood, 1 year old*	25	4½	15½	66	16	40¼	40	19	29¼	49	33	40
White Ash	14	3	9¼	34	8	22¾	31	6	19	48	16	26

*When transplanted.

The foregoing table affords an opportunity for studying the comparative growths, made by the different varieties, during the past four seasons. By comparing this table of growths with the meteorological table the comparative effect of wet and dry seasons upon the growth of each variety may be ascertained. This, to some extent, will indicate the ability of each sort to continue growth during dry and trying seasons. It must always be borne in mind, however, that each year's growth may be modified by certain conditions, such as the ravages of insect enemies upon some species, and the tendency to accelerated growth, as the tree becomes better established in others:

Month.	Rainfall.			Temperature.			Wind.	
	No. days.	Greatest in one day.	Total.	Highest.	Lowest.	Mean.	Northerly	Southerly.
1889.								
January	......	......	.3	41.°	-24.°	15.°	....	....
February	......	......	.5	43.°	-30.°	19.6°	11	....
March	......	......	.16	55.°	4.°	32.°	17	6
April	11	.27	1.025	83.°	12.°	51.20	10	15
May	9	.62	1.93	91.°	20.°	56.7°	15	8
June	11	.54	1.485	93.6°	36.1°	64.2°	15	14
July	9	.89	2.918	98 °	40.°	68.8°	11	16
August	3	.53	.72	97.°	41.8°	69.5°	6	15
September	4	2.22	2.70	89.°	30.°	55.1°	9	10
October	1	.005	.005	76.4°	23.8°	43.7°	18	10
November	......	......	......	28.°	-6.°	22.87	15	11
December	5	.475	.975	52.°	-11.°	26.78	13	18
1890.								
January	5	*2.	*6.5	43.9°	-28°	7.56	15	16
February	1	*2.	*2.	47.°	-35°	14.32	15	13
March	3	.31	.56	32.25	-4.°	19.69	13	14
April	4	.51	.787	84.°	10.°	46.71	10	12
May	17	.80	3.33	90.°	23.°	32.197	20	9
June	14	2.	7.91	90.5°	39.°	67.75	6	22
July	5	.54	1.535	94.5°	41.°	71.06	10	19
August	5	.88	2.07	99.°	35.°	63.8	14	16
September	5	.19	.45	91.°	25.°	57.5°	11	16
October	7	.12	.32	74.5°	21.°	38.8°	6	11
November	1	......	.03	68.°	0	29.41	22	12
December	......	......	......	58.°	-18.	21.2°	8	19
1891.								
January	......	......	......	52.°	-10.°	†	14	16
February	*3	*4.	*10.	48.°	-28	6.95	11	17
March	*2	*4.	6.	50.	-24.	17.94	13	15
April	9	.93	2.23	88.	11.	43.9	18	9
May	5	.38	.84	92.5	80.	55.54	17	12
June	11	1.34	4.09	89.	40.	62.5	15	14
July	7	.7	2.01	80.	60.	69.5	13	16
August—Frost on 23rd	7	.44	1.38	99.5	30.5	66.3	15	14
September	5	.27	.48	98.	23.5	65.1	24	6
October	2	.62	1.07	80.	19.5	45.4	15	11
November	......	......	......	......	......	......	....	....
December	......	......	......	......	......	......	1	2
1892.								
January	6	.20	.35	49.°	-34.°	8.33°	11	7
February	5	.20	.36	48.°	-19.°	18.78	14	9
March	3	.26	.84	65.°	- 7.°	27.10°	15	14
April	10	1.12	3.15	65.°	15.°	39.°	19	10
May	14	3.63	7.32	75.°	28.°	47.°	24	7
June	9	1.09	3.82	85.°	38.5°	62.8°	16	14
July	7	1.43	3.69	97.°	45.°	69.2°	12	19
August	11	1.19	3.03	94.5°	36.°	67.2°	11	20
September	3	.89	1.49	97.°	30.°	60.7°	15	15
October	3	.26	.53	92.°	.09°	49.2°	15	13
November	......	......	......	......	......	......	....	....
December	......	......	......	......	......	......	....	....

* Snow. † Observations not completed,

Total rain fall during growing season:—

April to November inclusive—1889, 10.783 inches.
“ “ “ 1890, 16.402 “
“ “ “ 1891, 12.10 “
“ “ “ 1892, 22.73 “

CONDITION AND GROWTH OF THE DIFFERENT VARIETIES.

The following discussion is made on the different varieties in order of their occurance throughout the plats, beginning with plat No. 7:

BLACK HILLS SPRUCE.

This variety occurs in plats 1, 24, 29 and 30. This is the first season in which the spruce has made anything like satisfactory growth. In 1891, the trees in plat 1 made an average growth of one inch, only a very few trees showing any tendency to put out a leading branch and to develop tree form. The trees of this variety in the other plats, being set that season, made almost no growth. During 1892 an average growth of three inches has been made by the trees in plat 1. A large part of them are establishing leading branches, the longest new growth being nearly six inches. The fact that these trees have made three times as great a growth as during any previous year is no doubt partly due to the unusually wet season. This indication is emphasized by the fact that, during this season, other spruces in plats of two years planting made greater growth than did these spruces at that stage of planting. Again, the spruces in plat 1 have, during this season, made greater growth than those of any of the later planted plats. This would indicate that, as the trees become longer established their yearly growth increases, and the increased tendency of the oldest trees to put out leading branches, would seem to confirm this probability. With the exception of the Scotch Pine, the Black Hills Spruce is the most promising evergreen now growing at this Station.

SCOTCH PINE.

This evergreen occurs in plats 1, 8 and 30. Like the Spruce just discussed, it makes slow growth when first transplanted, but grows more rapidly once it gets established. The trees in plats 1 and 8 were planted the same day. Those in plat 8 have made the best season's growth, Max. 25, Av. 14, and Min. 6 inches. In plat 1, the growth for the year is, Max. 19, Av. 11, and Min. 4 inches. The soil in these two plats is very similar in quality and elevation. Plat 8 has the better leaf canopy, not so much on account of the varieties of trees, as of uniformity of growth. This may account for the better growth of pines in this plat. In plat 30 the pines are the tallest trees, and have as yet no shelter. They have made poorer growth the past season than did those in plats 1 and 8, which had shelter the corresponding season after planting. This is the most promising evergreen growing at the Station, both for forest plats and for lawn planting.

BOX ELDER.

This most valuable nurse tree, is making best growth in plats 4 and 5, in which it constitutes three-fourths of the original planting. In plat 4, about one-half the Box Elders were two years old when set, the other half being trees of one year's growth. The two-year olds have made much the better growth from the first, and now average 12 ft. 6 in. in height, with a diameter of 2 to 3 inches one foot from the ground. These trees are past the stage of cultivation, having permitted the germination of actually no foul seed beneath their shade this season. Their growth has been remarkably even and their leaf canopy, during the past summer, was perfect. They have made an average growth this season of about 40 in., directing upward fine, straight boles, so that the plat now assumes the appearance of a fine young forest. Already a tendency to self prune is noticed, the lower branches being very weak and slender, and bearing few leaves, except at their ends, which, in their search for light, reach out and fill every opening thus making the shade more dense.

Though the Box Elder themselves are making fine growth, it must be borne in mind that they are only the temporary trees, to act as nurses to the Birch and White Pines, planted among them. Their shade seems to make very little difference with the growth of the pines, but, already, the Birches are showing the effects of their dense cover; those in more open places making a much better growth, (plat 10.) The Birch makes a somewhat slow growth, is more low and branching than the Box Elder, consequently the latter makes a poor nurse tree for it. The dense shade of the Box Elder, is in plat 4, all the more deleterious, as the Birches are effected with a fungus growth which seems to flourish best in shade. This fungus, while it has not yet seriously injured the Birches, has, during the past season, somewhat scrolled up their leaves, and contorted twig growth. As a nurse tree for the taller varieties of hard wood, like Elm and Ash, or for any shade enduring sorts, the Box Elder surpasses any other tree in the forest plats. This is illustrated in plats 5 and 7, where the hard woods are making excellent growth. The Ash and Elm keep well up with the Box Elder in height growth, and so hold their ground.

THE POPLARS.

Cottonwood, (*Populus monilifera,*) *Populus certinensis*, and *Populus nolesteri:* Much may be said of these trees in common. They have much the same appearance, and are similar, though not identical, in habit of growth, hardiness, and value as nurse trees, so far as tried at this Station.

The Cottonwood makes the most rapid height growth, one, 17 ft. high, and 3¾ in. in diameter being the tallest tree in the plantation. This variety predominates in plat 2. Here many of the largest specimens have already began to die, branch after branch dropping its leaves, and drying out, until on some trees very few branches retained their vigor throughout the past season. This seems to be a very common fault with the cottonwood in many localities throughout the Dakotas. It seems to endure thin planting better than dense, succeeding best, where it is planted in a row, at long distances, along streets and drives. The trees in the plantation have suffered some from the cottonwood leaf beetle (*Lina Scripta*) but not so badly as have the *P. certinensis.* Cottonwoods that have become established along the streets and drives, in this county, have, in many cases attained a very large size, and are still thrifty. So far as I can learn, these large trees are not molested by the leaf beetle. *P. certinensis* is a better nurse tree than cottonwood. It makes a less rapid height growth, and thus enables Ash and Elm to keep pace with it. While under the cottonwoods in plat 1, the weeds gain a foot-hold, from the trunk of the tree out, under the *P. certinensis* the ground is free from weeds from the trunk well out even with the tips of the lower branches. The last named tree suffers most from the leaf beetle. In 1891, the growing points of the *certinensis* were almost denuded of their leaves by the ravages of this insect. In the fall after the beetle had disappeared, these branches put out a new growth of leaves. As was at the time anticipated, all this new growth died back during the winter. This season, a similar occurrence, though in a less degree, has taken place, and we may expect a corresponding dying back the coming winter. The ravages of this beetle were measurably checked during this season, by spraying the trees with London Purple, one pound to 200 gallons of water.

The tallest *P. certinensis*, planted in 1889 is 11 ft. 8 in. in height and $2\frac{3}{4}$ in. in diameter, one foot from the ground. The average height is about 9 feet.

EUROPEAN LARCH.

Perhaps no other tree in the forest plats has shown greater improvement over previous season's growth than has the Larch. It occurs in plat 3, the nurse trees in this plat being Box Elder. Heretofore, the Larch has shown little or no tendency to establish a leading branch. During the first few years, it merely developed a mass of lateral twigs, which, interlacing, gave the tree much the appearance of a tumble weed. Last season a few trees put out leaders, and began upward growth. During the present season, nearly all have began developing tree form, making an average growth of 25 in. of new wood. The largest specimen is now about 6 ft. tall, having put out 37 in. of new wood this season. They showed no tendency to die back during the past winter, and this year's growth was for the most part, directed straight upward from the main stem.

YELLOW BIRCH.

This tree has made its best development in plat 10 where it has hard woods for all its neighbors. It seems to like bright sunshine, a fungus growth which effects its leaves, doing less damage in this open plat, than in plat 4, where the Box Elders overshadow it with their shade. None of the trees have died this season, and the tree, thus far, seems to withstand this climate well, once it gets established. The Birch is a dense shade tree, allowing no weeds to grow beneath it. Thus far no deleterious effects from using hard woods entire, in this plat, can be noticed. Whether or not they will continue to thrive as well as they would with soft wood neighbors remains to be seen as growth continues. It will be noted from the table that the annual growth of the Yellow Birch has increased each year. The trees now average about 9½ ft. in height, the largest being 13 ft. high, with a diameter of 3½ in., one foot from the ground.

WHITE BIRCH.

For the four seasons since the plantation was begun, the growth of the White and Yellow Birch has been nearly parallel, some years the balance of growth being in favor of the one, and again, in favor of the other. This season, the White Birch has made less growth than has the Yellow. The largest White Birch is 12 ft. high, and 3½ in. in diameter, one foot from the ground. The Birches succeed well, not only in the cultivated plats, but as a lawn tree. The cut leaf, or Weeping Birch, is one of the finest ornamental trees on the College grounds.

BURR OAK. (*Quercus macrocanpa.*)

The Burr Oaks in the plantation are yearly becoming more promising. They grow very slowly at first, but during this time they are making strong root growth, so that once established, they withstand the trying features of our climate with impunity. At time of transplanting, care should be taken not to mistake live trees for dead ones, as they nearly always look dried and lifeless, when taken up. During the present season, those trees that have only moderate shade from the Box Elders, have made a little better growth, than those growing in that section of the plat, where the nurse trees are larger, and shading denser. The largest Oaks in the plat are about 4 ft. in height.

WHITE ELM.

The Elm is one of the most desirable hard wood trees yet planted at the Station. It has few insect enemies, is a strong, vigorous grower, and, year by year, proves itself more valuable.

Once established, it makes a very rapid height growth, keeping well in pace with the Box Elder as a nurse tree, so that it will endure planting where a dense leaf canopy is to surround it. This season, it has made its best growth in that part of plat 5, where the best stand of Box Elders, as nurse trees was secured, and where the leaf canopy is as nearly perfect, as in any part the plantation. The second best growth was made in the ha wood plat, 10. In this plat, the leaf canopy is superior to tl of most of the soft wood plats, except 4 and 5. The largest E in the plats is 12½ ft. high and has a diameter of 2½ in.

ASH.

As a hard wood the Ash promises to be equal, if not superior to the Elm for this vicinity. It is more hardy, more easily transplanted, seems to endure drought better, especially in its early stages, and makes a more valuable wood than Elm. Here it suffers more from the ravages of the Ash borer, than does the Elm from any insect enemies. In growth it keeps well up with the Elm. The largest tree in the plats is 10 ft. 3 in high and 1¾ in. in diameter, a foot from the ground. Plats 21 and 20 planted to Ash and Elm respectively show a more nearly equal comparative growth than do plats 14 and 15 planted to the same varieties. The two first mentioned plats are very low, and were very wet, during the growing season. The two latter named are on higher and dryer ground. The growth in these four plats, indicates that Elm makes more rapid comparative growth on low wet land than does the Ash.

BLACK WALNUTS.

The walnuts were slow growers at first and many died the first few seasons. For the past year none have died. All that once succeeded in establishing themselves are growing well. Those that have most shade, thus far tend to outgrow those in sunshine. The tallest is 6 ft. 3 in. high.

SOFT MAPLE.

Heretofore, the records of each season accredited this tree with dying back badly during each winter, and sending up tufts of shoots of nearly equal size, each summer. The past season seems to have been no general exception to this rule, but in plat 8, where the largest tree has reached a height of 11 ft., there seems to have been very little killing back last winter, and a greater tendency than usual to establish leading branches. In a good many specimens in this plat, an upward growing branch has taken the ascendency, and promises a good, symmetrical growth. In plats 18 and 19, planted one year later, very few specimens have shown any tendency to develop tree form. The actual height of the trees, is very little above what it was a year ago, there being in most cases only a number of withes at each crown. As this tree is not a strong one, this tendency to form forked branches of equal size, results disasterously to the tree growth, by these branches splitting down, as soon as loaded with leaves. The maples in plats 25, 26 and 27 were planted one year later than those in plats 18 and 19. The trees were ordered from the same nursery, but very few died back. They are making rapid, symmetrical growth, and at present promise well as nurse tress. A greater annual growth was averaged by trees that died back. This unusual growth, may result in leaving the tissues infirm, and unable to withstand the winter; hence the continued tendency, in trees that have once winter-killed.

TO FARMERS AND STOCKMEN.

The Veterinarian of the Experiment Station, desiring to secure at all times as much information as possible regarding the diseases of domestic animals in this state, and to assist farmers and stockmen, would be pleased to receive and answer all letters that may be addressed to him concerning any matters in his department. Such letters should be as definite as possible in the statement of symptoms and other attendant facts.

In case of suspected outbreaks of contagious or infectious diseases he will endeavor to visit the locality and give such advice and assistance as may be possible, on condition that his necessary expenses are paid by the owners of stock suppose to be affected, or by the county commissioners. All communications should be addressed to

D. A. CORMACK,
Brookings, S.

SOUTH DAKOTA
AGRICULTURAL COLLEGE
AND
EXPERIMENT STATION

BROOKINGS, S. D.

BULLETIN NO. 33.

FEBRUARY 1893.

Department of Botany and Entomology.

BOTANY.

DUTCHER, BREED & STORGAARD, BROOKINGS.

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The Bulletins of this Station will be sent free to all citizens of the State who will apply for them.

All letters and other mail matter for the Station should be addressed to the Experiment Station.

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I., Loco Weeds.
II., Rattlebox.
III., Ergot.

NOTICE.

During the past two years many inquiries have been received regarding the possible injurious nature of various plants. In many cases such poisonous plants as "rattlebox," and the "loco weeds" have been sent, while in many others, perfectly harmless plants have been sent to us with assurances of their injurious nature. With a view to calling attention to a few plants that are quite certainly injurious the present bulletin has been issued. It will serve as a preliminary step towards a full investigation of all Plants Injurious to Stock found in our state.

It is hoped that stockmen and farmers throughout the state will aid in the work by reporting cases of certain or possible injury done by plants and by sending specimens of plants suspected.

Our thanks are due the Department of Agriculture at Washington, for plates I and II, and to Dr. C. E. Bessey for plate III. Plates IV and V are from original drawings by Mrs. E. M. Williams. Our thanks are also due to the various farmers and stock raisers who have kindly answered our questions and given us much desired information.

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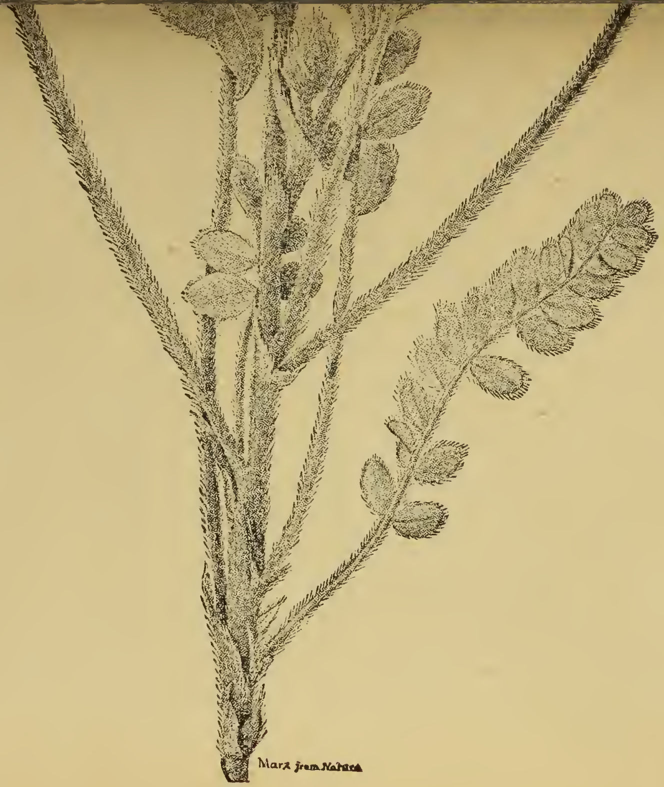
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SOME PLANTS INJURIOUS TO STOCK.

THOMAS A. WILLIAMS.

I. LOCO WEEDS.

Throughout the great stock raising regions of the west there is more or less damage resulting from a disease known as "loco." This disease is caused by stock eating one or more plants called "loco plants," "crazy weed" or "loco weeds."

The plants belong the pea family (*Leguminosae*) and are mostly members of the genus *Astragalus*, the milk-vetches. One belongs to the genus *Oxytropis*. The following plants found growing in South Dakota have been reported as causing "loco:" *Astragalus mollissimus*, *Astragalus lotiflorus*, *Astragalus bisulcatus*, *Astragalus haydenianus*, and *Oxytropis lamberti*. Of these the first and the last are old offenders and there seems to be but little doubt regarding the second, but it seems hardly probable that stock can get enough of the third and fourth to cause much injury. However since so many of the genus are known to cause "loco," these last may well be regarded with suspicion; particularly as several species closely related to them, found in California are regarded as injurious.

The following descriptions and plates of our commonest "loco weeds" will aid in recognizing them:

ASTRAGALUS MOLLISSIMUS, Torr.

(Plate I.)

ROOT: Perennial, large and tough, deep growing, forming large, strong root-stocks above from which proceed the short, clustered stems.

STEM: Short, more or less reclining below, densely silky-hairy, usually in large clusters from the root-stock, more or less branching.

LEAVES: Appearing to arise from nearly the same place because of the shortness of the stem; 6 to 10 inches long; composed of from about 19 to 29 leaflets, which are ovate-oblong, or oval, obtuse, or slightly mucronate, and from one-half to an inch in length, with a dense soft, silky, white or yellowish pubescence. Stipules rather conspicuous, lanceolate, very acute, free, cohering below the petiole.

FLOWERS: Rather large, an inch long, violet, arranged in a dense spike on a flowerstock usually as long or longer than the the leaves; calyx tubular, silky-hairy, with slender teeth two-thirds as long as the tube.

PODS: Smooth, cartilaginous, oblong, becoming incurved, ½ to ¾ of an inch in length, pointed above, more or less completely two-celled with several to many seeds in each cell.

SEEDS: Small, one-twelfth to one-eighth of an inch in length, bean shaped, smooth, more or less compressed, brown to dark brown.

This weed grows in dry prairies and on dry rocky hills in the western part of the state, not in any great quantity however.

ASTRAGALUS LOTIFLORUS, Hook.

A much smaller plant than the preceding species.

ROOT: Perennial, long and slender, yellowish, usually branching but little.

STEM: Very short, covered with short oppressed hairs, occasionally branching.

LEAVES: Composed of 7 to 15 lance-oblong, ½ to ¾ inch long, leaflets.

FLOWERS: Yellowish, arranged in few flowered head-like spikes; calyx pubescent, teeth subulate, exceeding the tube; flower-stalks either very short or exceeding the leaves.

PODS: ¾ to 1 inch long, oblong-ovate, long pointed above, acutish at base, canescent becoming smooth with age, more or less impressed on the back, straight or somewhat curved with age.

SEEDS: Sub-orbicular flattened, irregularly pitted, brown, the place of attachment making a deep notch in the side.

Very plentiful in sandy soil throughout the western part of the state, particularly along the Cheyenne and Missouri rivers. During the summer of 1891 it was found growing in great quantities along the Cheyenne river bottoms. Many stockmen assert that it is surely the cause of "loco," while others think it harmless.

ASTRAGALUS BISULCATUS, (Hook.) Gray.

ROOT: Perennial, usually large and strong, giving rise to a large cluster of stems.

STEM: Erect, smoothish or with minute oppressed hairs, 1 to 2 feet high, becoming rather robust and woody.

LEAVES: 3 to 6 inches long; composed of about 15 to 21 leaflets, which are oblong, or narrowly oblong, obtuse and mucronate or slightly retuse, $\frac{3}{4}$ to 1 inch in length, nearly smooth or with rather short, oppressed hairs; lower leaflets rather close to the stem.

· FLOWERS: Violet, arranged in dense spike-like racemes, usually over half an inch long; calyx teeth very slender and sharp, nearly as long as the tube.

PODS: About half an inch long, with a short but distinct stalk or stipe, narrowly oblong, semi-cylindric, with a deep suture, smooth, thick and leathery in texture, one celled, many-seeded.

SEEDS: Dull black, sub-elliptical, irregularly compressed, with a deep notch on one side near the end.

Not uncommon in the Black Hills and Cheyenne river regions and in the Bad Lands. Can be usually recognized by its rather large size, violet flowers and deeply sulcate pods

ASTRAGALUS HAYDENIANUS, Gray.

This plant is very like the preceding species, but is distinguished by its smaller flowers which are white with but a tinge of purple, shorter calyx teeth, strong disagreeable odor, and smaller size of the whole plant.

It is found in about the same localities as the preceding species. It seems that stock would not be likely to eat much of it because of its strong odor and bitter taste.

OXYTROPIS LAMBERTI, Pursh.

(Plate II.)

ROOT: Perennial, becoming large, tough and woody, and growing deep into the soil.

STEM: Very short and thick, usually in clusters from the thick woody root-stocks.

LEAVES: Coming out so close together on the short stem that they seem to come directly from the ground, six inches to nearly a foot in length, with from 11 to 21 oblong-lanceolate or linear, silky, and silvery-pubescent leaflets, often becoming smooth and glabrate with age. Leaflets $\frac{1}{3}$ to $1\frac{3}{4}$ inches long.

FLOWERS: Usually large, nearly an inch long, purple, yellowish, or white, in a close, often elongated spike on a stiffly erect flower-stalk arising directly from the root-stocks.

PODS: Erect, $\frac{1}{2}$ to 1 inch in length, narrowly to broadly oblong, pointed, hairy, firm and leathery in texture, imperfectly two-celled.

SEEDS: Brown, orbicular, smooth, usually numerous in the pods at first but seldom all maturing.

The commonest of all our "loco weeds," being found throughout the whole state, growing mostly in dry prairies and on dry ridges. It is capable of enduring severe drought, and remains comparatively fresh and green long after the grasses are dried up.

All the "loco weeds" have flowers similar in shape and general appearance to those of the common garden pea and bean, and belong to the same family.

EFFECT OF LOCO WEEDS ON STOCK.

Until very lately it has been the universally accepted belief that the injuriousness of "loco" plants was due to some poisonous principle, probably an alkaloid, contained in the plants themselves. This is the belief generally held by the stockmen best acquainted with "locoed" stock. It is thought that the poison affects the whole nervous system as well as the digestive organs. The brain becomes diseased causing the animal to "go crazy," (hence the term "loco," a Spanish word meaning foolish or crazy.)

The "loco" plants appear early in the spring when other vegetation is scarce and persist during drought when grass becomes dried up, hence at such times more danger is to be apprehended. Ordinarily stock does not at first like the taste of the "loco"

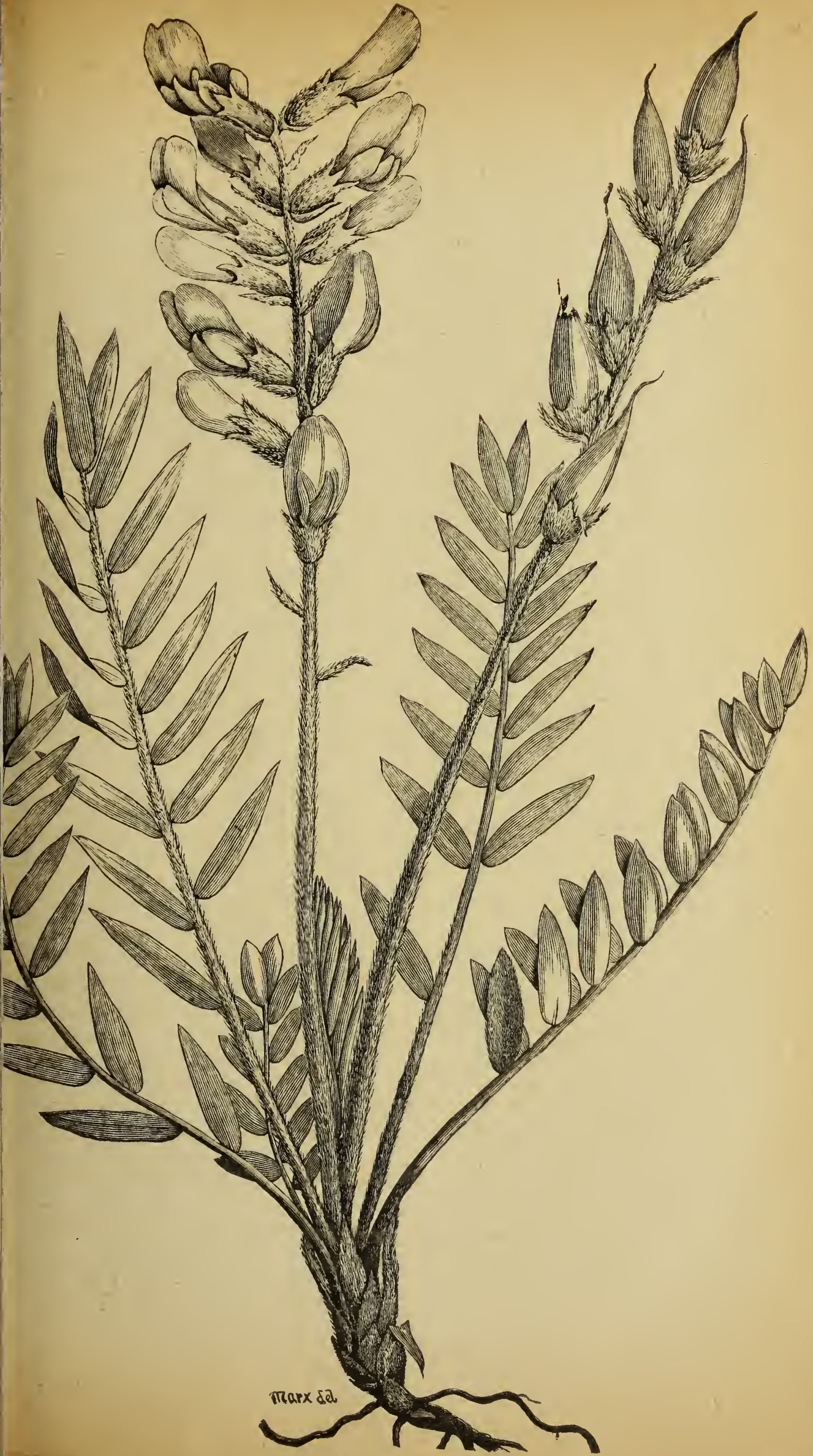

PLATE II.

plants, and eats them only when other food is scarce. After the taste has been once acquired however nothing else will be eaten and the animal either dies from eating enough of the "loco" plant to drive it crazy, or form starvation, or from both of these causes. It is more than likely that the last is usually the case.

Dr. N. S. Mayo[1] is of the opinion that the disease is not due to poisoning but "is the result of mal-nutrition, or a gradual starvation, caused by the animals eating the plants known as the 'loco weeds.'" He comes to this view after a series of experiments and observations made by himself.

The following account given by a correspondent in California to Dr. Vasey[2] describes very forcibly the symptoms of a "locoed" animal:

> Cows are poisoned by it as well as horses, but it takes more of it to affect them. It is also said to poison sheep. As I have seen its action on the horse, the first symptoms of the poisoning is hallucination. When led or ridden up to some little obstruction, such as a rail or bar, lying in the road, he stops short, and, if urged, leaps as though it were four feet high. Next he is seized with fits of mania, in which he is quite uncontrollable, and sometimes dangerous. He rears, sometimes even falling backward, runs or gives several leaps forward, and generally falls. His eyes are rolled upward until only the white can be seen, which is strongly injected, and, as he sees nothing, he is as apt to leap against a wall or a man as in any other direction. Anything that excites him appears to induce the fits, which I think are more apt to occur when crossing water than elsewhere, and the animal sometimes falls so exhausted as to drown in water not over two feet deep. He loses flesh from the first, and sometimes presents the appearance of a walking skeleton. In the next and last stage he only goes from the "loco" to water and back; his gait is feeble and uncertain; his eyes are sunken, and have a flat, glassy look, and his coat is rough and lustreless. In general, the animal appears to perish from starvation and constant excitement of the nervous system, but sometimes appears to suffer acute pain, causing him to expend his strength in running wildly from place to place, pawing and rolling, until he falls and dies in a few minutes.

Dr. Mayo, in the above mentioned bulletin describes the course of the disease as follows:

> In the early stages there is a general sluggishness and difficult locomotion, a stiff and stilted action of the the legs, and trembling of the

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1. Kans. State Exp. Station, Bulletin No. 35, p. 16, Topeka, 1892.
2. Report of the U. S. Dept. of Agriculture, p. 75. 1886, Washington.

involuntary muscles. If an animal is lying do[illegible]d attempts to rise, it often requires several efforts, and the a[illegible] may turn one or more complete summersaults before gaining [illegible]eet. The head trembles quite violently, and the animal may open [illegible] mouth and hold it open for some time. In later stages of the disease the animal is emaciated, and there is a swelling of the dependent portions of the body, the head, or muzzle, and legs. Another characteristic symptom is a peculiar vacant stare. The optic nerve is not affected, as the animal seems to receive impressions readily, but from some abnormal condition of the brain is unable to comprehend them. The animal will stand and stare for several minutes at some familiar object, exhibiting all symptoms of fear, until finally the true nature of the object seems to dawn upon its brain. A locoed steer which had been without water for several days came to the tank where it usually drank, for water, but was unable to obtain it, through fear of falling into the tank. It drank readily from a bucket.

Locoed cattle do not shed the hair readily in the spring, and in midsummer can be distinguished by the ragged patches of old hair still clinging to the animal. * * * * Locoed horses exhibit the same general symptoms as cattle. They are uneasy and weave about when standing, and can be lead or pulled along with much difficulty. A straw, stick or shadow across the path may cause a locoed horse to sheer violently to one side, or jump several feet high, in order to clear the obstacle. If allowed to stare at it a few moments, the horse may pass it as usual. Locoed horses are subject to fits or "crazy spells." These fits are especially liable to occur when an animal is working, and the day is warm. During a paroxysm, the animal is delirious, and may rear and plunge violently, often falling to the ground in an unconscious condition, the eyes rolling in the sockets or turned so as to expose the whites. They usually recover from these fits in a short time. It is generally conceded that a locoed animal, though deprived of the loco weed until broken of the habit of eating it, never amounts to anything afterwards, either for work or to feed.

TREATMENT.

Much more can be done by prevention than in any other way. This is usually difficult to accomplish, as some of the plants are so common that it is almost impossible to keep animals from having access to them. As long as plenty of good, fresh grass can be had there is usually little danger to be feared. Early in the spring and late in summer, or in autumn, however all stock in localities where loco plants are found should be watched closely. At the first appearance of the trouble, affected animals should be removed to some place where no loco plants are accessible. Good nourishing food should be given. They should not be allowed to feed where the weeds can be had so long as any taste for the plants remains. As the taste is as slow to be lost as it is to be acquired, a considerable time is usually necessary to effect a complete cure. If the disease has obtained a very strong hold upon the animal, recovery is doubtful under any circumstances, hence the need of catching it in its earliest stages. So far, all medicines that have been tried have been of doubtful benefit. Good care and nourishing food is more to be relied upon than medicines.

Dr. Mayo, in the above mentioned bulletin, recommends the following mixture to be given in the food three times daily, in doses of a "heaping teaspoonful to a tablespoonful, according to size of animal."

Sulphate of iron, pulverized	1	ounce
Gentian root, pulverized............................	4	"
Ammonia muriate, pulverized..........................	1	"
Potassium nitrate, pulverized........................	1	"

Mix thoroughly.

II. RATTLEBOX.

This plant is found to a greater or a less extent throughout the United States east of the Missouri valley region. It seldom occurs in any great quantity in any one locality. It is very plentiful, however, along the bottom lands of the Missouri river, from Council Bluffs, Ia., to Chamberlain, S. D. Last season it was exceedingly common in bottom hay. A plate and description of the plant is appended. It is known botanically as:

Crotalaria sagittalis, Linn.

(Plate III.)

Root: Annual, simple, tapering gradually, and with a greater or less number of rootlets branching out at irregular intervals, whitish or yellowish.

Stem: From 8 inches to a foot and a half in height, usually much branched, covered with spreading, whitish hairs, roundish, with wing-like petioles just below the leaves, which give it more or less of an angled appearance. These wings are broader above and gradually become narrower below.

Leaves: Usually from 1 to 2 inches long and from $\frac{1}{3}$ to $\frac{2}{3}$ of an inch wide, narrowly oval, with the ends rounded, or becoming more or less pointed, more or less hairy, particularly on the margins which are entire or slightly wavy, green, paler beneath.

Flowers: Yellow, rather small and inconspicuous, scarcely over a quarter of an inch long; calyx with rather large, hairy leaf-like divisions, usually longer than the corolla. Flowers usually more or less clustered on slender branches which usually come out opposite the leaves.

Pods: Rather large, $\frac{3}{4}$ to an inch in length, and $\frac{1}{3}$ to $\frac{1}{2}$ an inch in diameter, rounded at the ends, with at small hook-like projection on the upper or outer end. They have a slight suture, or crease, along the upper side and one along the

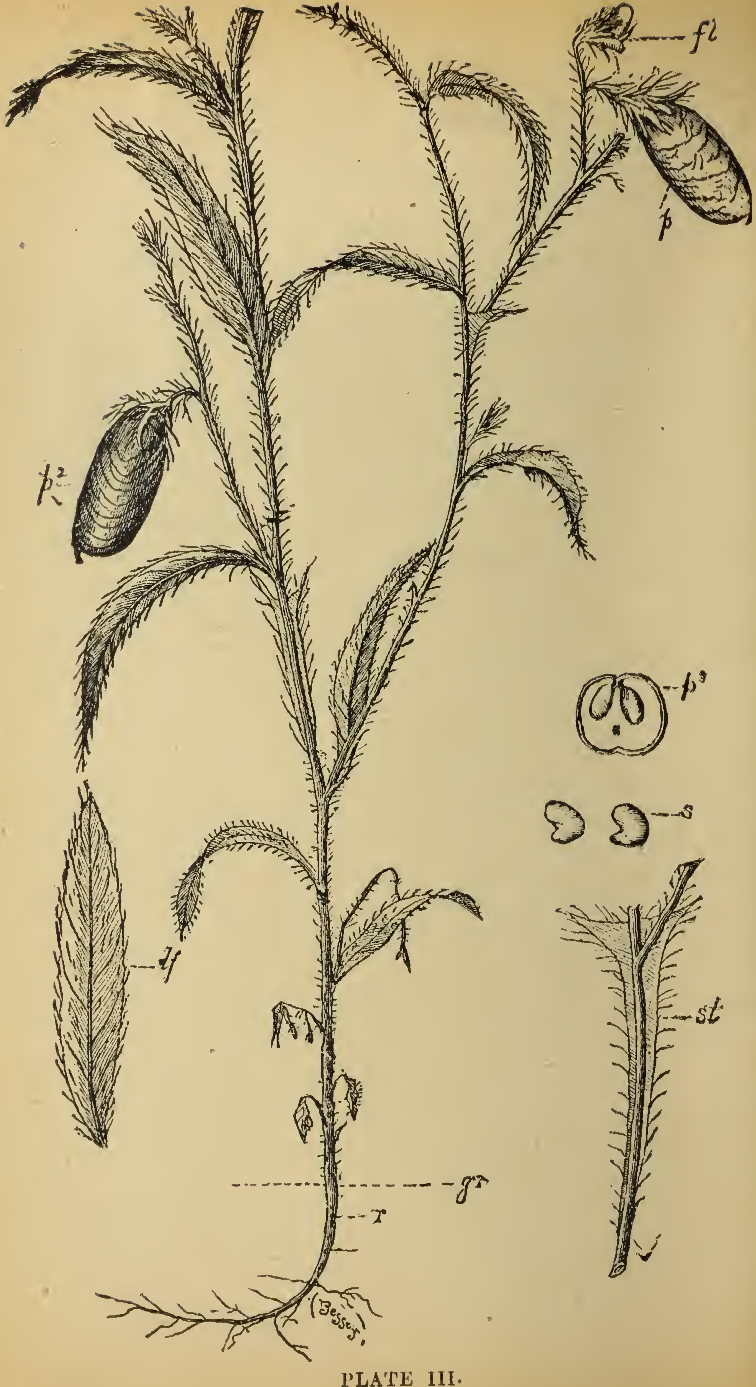

PLATE III.

under side. As the pods ripen they become stiff and blackish in color. They have no hairs on the surface, but are smooth and occasionally wrinkled.

SEEDS: Flattish, kidney-shaped, rich brown, smooth and shining, about one-tenth of an inch in diameter. They are attached along one side of the pod and when ripe break off before the pod opens, forming a vegetable rattle, hence the common name—rattle box. The plant prefers a sandy soil, and so thrives exceedingly along the river bottoms.

It is easily killed out by cultivation, and so may be gotten rid of by plowing up infested fields and sowing them to any of the cultivated forage plants. It does not occur on the uplands, but creeps up gullies and draws, and may occur in quantities sufficient to do more or less damage even when most of the pasture is on the upland, especially if feed is short in the pasture.

THE RATTLEBOX, (Crotalaria sagittalis Linn.) a little less than natural size; showing at r, the root: at gr, the ground line; at fl, a flower; p, a young pod; p2, an old pod; at p3, a pod cut across to show the seed; at s, two seeds about twice the natural size; at st, a portion of the stem showing the wings; at lf, a leaf, natural size. (After Bessey.)

HISTORY.

The first record we have of the injurious character of this plant is given by Dr. Stalker, of Iowa, in Sept, 1884. The outbreak occurred on the Missouri river, between Council Bluffs and Sioux City. Dr. Stalker made an extended study of the trouble and came to the conclusion that there could be no doubt that "rattlebox" was the cause of the disease prevalent among horses in that region at that time. He gives the following notice of the disease and his own experiments and conclusions:[3]

CROTALISM—A NEW DISEASE AMONG HORSES.

Some two months since repeated calls began to be made on my office through letters from various localities between Council Bluffs and Sioux City, for information concerning a highly fatal form of disease prevailing among the horses. These letters came from towns in Iowa, Nebraska, and Dakota, but in every instance from locations in the Missouri valley. I went out in answer to these calls and soon learned that the situation was one of sufficient gravity to justify alarm. After visiting a number of towns along the line of the Sioux City & Pacific railway, and making long excursions into the country, I gathered sufficient history to justify the estimate of fatal cases at several hundred.

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[3] Bull. Iowa Agricultural College, Dep't of Botany, Nov., 1884. Copied from the Daily State Register.

The disease had been known in this region for three or four years, but had not until the present summer prevailed to such an extent as to attract general public attention. But now the loss in horse stock on some farms was not to be counted by hundreds, but by thousands of dollars. The disease proved to be one that had not hitherto come within the range of my experience, nor had I any information of anything exactly identical with it. I spent several days among the farmers on the Iowa side of the Missouri river, taking careful notes of the symptoms, and gathering the history of the progress of the disease. On some farms I found almost all the horses affected, and on others but a few individuals. Deaths were an almost daily occurence, and the farmer who owned a large stock of horses did not know to-day whether he would have teams for his farm work a week later. The disease in most cases is very slow in its progress, but proving almost uniformly fatal after a number of weeks or months. There is a general decline of bodily vigor throughout this period, and the only abnormal symptom in many cases is that of marked emaciation and consequent weakness. Horses that have been kept at pasture through the summer, without work, and where the grass grew in the greatest abundance, were so thin in flesh that they walked with the greatest difficulty. A critical examination of many of these patients revealed nothing more than the conditions resulting from starvation. This was not uniformly the case. In a number of instances there was marked coma or stupor, the animal often falling asleep while eating. In some instances the animal would ramain standing for a whole week, sleeping much of the time with head resting against some object. In a few instances the animals lost consciousness, and broke through fences and other obstructions. A number of diseased animals were placed at my disposal, and assisted by Dr. Fairchild and Dr. Milnes I made post mortem examinations of five subjects with the most perfect uniformity as to the lesions presented. In every instance there was marked hæmorrhagic effusions into the fourth ventricle, the liver and spleen were abnormally dense, the walls of the intestines were almost destitute of blood, and the stomach enormously distended with undigested food. The stomach with its contents in some instances weighed as much as seventy pounds. These post mortem conditions, together with the clinical symptoms led me to believe the animals were obtaining some poisonous principle with their food. The symptoms in some cases bore such a resemblance to those produced by eating Astragalus mollissimus, or "loco plant" of the Western plains, as to direct my investigations to that family of plants. A careful examination of the meadow and pasture lands was not rewarded by the discovery of a single "loco plant."

It took but little investigation, however, to find a closely related plant growing in great abundance, both in the meadows and pastures.

This was the Crotalaria sagittalis, or "rattle-box." This is also known as the wild pea, and is accounted by many farmers as the best of forage plants. Knowing the bad reputation of some of its near relatives, I determined to make some experimental tests with the plant. I employed a boy to collect about thirty pounds of green plants, which I brought with me on my return to the college. I procured a strong young horse, affected with incurable catarrh, and attempted to induce him to eat the plant. This he persistently refused to do, though I sharpened his appetite by a protracted fast. It is a matter of common observation that animals eat it with the greatest relish in localities where it grows. Failing to induce the animal to take the plant voluntarily I prepared a strong infusion, and by means of a stomach pump gave the preparation obtained from about ten pounds of the plant. In twenty minutes stupor began to ensue, the eyes were closed, the head was rested against the side of the box, the breathing became stertorous, and all the symptoms developed that were to be seen in the patients previously examined. At the end of six hours the stupor began to disappear, the eye began to regain its brightness and in another hour the horse began to eat. The following day, when he had apparently recovered from its effects, he was given half the quantity of the drug as on the previous day. In this instance the symptoms were developed much more rapidly, the animal became unconscious in a short time and died in an hour and a half. The post mortem revealed the same condition of the brain as in the cases examined in the western part of the State. I now resolved to make a second experiment, in which the animal should receive a small quantity for a number of days in succession. Having procured another subject for experimentation, and a bushel of mature fruit, or pods of the plant, I commenced on Sept. 5th to give daily the infusion obtained from about one quart of the pods. On the fifth day of the experiment the characteristic stupor came on. The animal rested its head against the box and slept while standing. The symptoms grew more marked till the thirteenth day of the experiment, when the animal died. The post mortem showed the same as in the other cases. These experiments leave no doubt in my mind that the trouble along the Missouri river is occasioned by the animal's feeding on this little plant. It is from eight inches to a foot in height, with branching stems bearing yellow flowers in July and developing large pods resembling the pea, but containing a number of black, hard seeds. It grows on sandy bottom land, and is very abundant in the meadows and pastures in portions of the Missouri bottom. It is seldom seen among the tame meadow grass in any considerable amount. It thrives best among the wild grasses. Animals, doubtless, eat it much more than formerly, when the wild pasturage was better than at present. Cattle sometimes, though not often, suffer in the same way as horses.

For several years the farmers living in the counties lying along the Missouri river from Chamberlain to Sioux City have lost a greater or less number of horses from a disease which is apparently identical with that studied by Dr. Stalker. The last season it has been particularly troublesome some men losing as many as 15 to 20 head. From some of the numerous letters received from these parties the following extracts are taken to give an idea as to the character of this disease as seen by the farmers who suffer the losses. A correspondent in Elk Point says:

Disease commences with rough coat and slight falling off of appetite which increases from day to day until the animals finally refuse all ordinary feed but will eat rotten wood, manure, etc., and at last get delirious and die. Have known some to live three months after being taken, while others will not live more than two or three weeks. We call it "bottom disease," for the reason that stock on the high land seems to be exempt.

A gentleman at Vermillion who has had considerable experience with the disease gives the following account of it:

I have lost 17 head of horses within the last nine months ranging from yearlings to horses 13 years old. I believe (and shall until it is proven to me to be untrue) that a small plant known generally by farmers on the Missouri bottom as "Rattlebox weed," is the cause of all of it. The plant grows so far as we now know only on the Missouri bottom land. It is a crooked branching plant from 6 to 8 inches high, belonging to the family Leguminosae. Has a leaf somewhat the shape of a sage leaf and pods about $\frac{3}{4}$ of an inch long with little flattened brown beans which are very hard when ripe, and rattle when dry, in the pod which is bluish black and largest at the extreme end.

My hay had a great deal of this weed in it and my horses had all they could eat. Three cows were also fed on the hay. Cow's milk was stringy and had a bad smell; otherwise it does not seem to effect them.

Horses first lost their appetites for grain and slowly fell away. There was a marked tendency to urinate often, and a disposition to wander around and eat old rotten hay or straw, and an apparent weakening of the whole system. The legs seem to twist around and to have little or no locomotive power; hind legs often crossing as the animals walk. There is a disposition to lie down much of the time as the disease advances.

I opened several animals and diagnosed as well as I could. I found that if any of my horses, while in comparative health had had a weakness in any particular organ, when the disease set in, it went to that organ. All that had been troubled with urinary ailments before taking this disease were found to have the kidneys almost rotten after death, while those that had not been liable to kidney trouble had these organs apparently fresh and healthy. In like manner if animals had been previously subject to lung troubles, these organs were most affected. The animals acted differently, some went crazy; others would jump up into the manger in agony; all run much from the nostrils when dying and after death. Sometimes there was great swelling of the limbs and sheath and under part of the abdomen accompanied with anxious looks towards stomach as if in pain. There is generally a slow falling off in flesh until the animal becomes a mere skeleton too weak to get up or to walk.

I find that all who fed hay containing the weed in any quantity, lost horses. It does not grow so plentifully every year, and is usually confined to spots where the soil is inclined to be sandy and where blue joint grass is found. It does not grow where the wide blade bottom grass occurs.

The following report from Bon Homme county suggests the possibility that in some cases animals may suffer from loco and crotalism at the same time. The symptoms of both diseases are very similar and animals feeding in upland pastures would be more likely to get "loco weeds" as they grow on the dry uplands while "rattlebox" grows on the bottom lands:

I have lost 7 head of horses with the disease. The first was a four-year-old mare. She was taken sick in May and had never run on the bottom but had been fed bottom hay during March and April.

We called a horse doctor who said she had inflammation of the bowels and and bladder. He gave her some medicine and the next day she was worse. When he came again he was puzzled. He then took her home with him and doctored her for two weeks. Shortly after he took her she cast her colt, then only three months along. She finally went crazy and died. He said she had brain fever! The next was a four-year-old mare suckling a colt. We had used her in spring work and had turned her in upland pasture the latter part of May. Took her up again about the middle of June to cultivate corn. After the first day's work she was off feed. Thought my men had overfed her. Her symptoms showed enteritis and I doctored her for that. She seemed unable to eat grain but would nibble at dried "Russian thistles" and dirt. At the last I gave her a dose of oil (in the afternoon about 2 o'clock) and the next forenoon she was dead. Both of these mares if turned in the yard would walk like a drunken man and would run right into the fence.

The next was a three-year-old Clyde stud. He was running in upland pasture. * * * * One day at noon I missed him and found that he had evidently broken through the fence. I found him a mile from home wandering in an oat field, stone blind and crazy. He had gone through four wire fences. I put him in a box stall where he would get his breast against the manger and push until the sweat would run off him in streams. I found that he had inflammation under the skin of his left leg and side, mostly along the neck and shoulder, just as in "black leg" in cattle. His right side seemed quite natural. He died the next forenoon. The next was a three-year-old Clyde stallion that I had worked some and kept in the barn. The first I noticed was on a Thursday night in July. He did not care to eat and seemed to be getting gaunted up. Some of my neighbors who were in the barn thought there was nothing the matter with him. * * * * * There were no marked symptons with him. When he died, the follow-Tuesday, I opened him and found his lungs just like liver, while his bowels and stomach seemed all right except that portion of the stomach next the lungs which was a little inflamed. I took part of his lungs to a horse doctor who said the horse died of pneumonia. I next noticed that a five-year-old mare suckling a colt, and that had run in the pasture all summer, was losing flesh. Supposing it was because of the colt, I took it from her and put her in the barn. The next day she showed signs of lung trouble and would not eat grain. Gave her aconite and whiskey three times a day and bathed her all over with black oil liniment; the third day she seemed better and ate a few oats, but on the fourth day she began to get worse and died two days later. I opened her and found lungs, stomach and bowels almost rotten. I next lost a horse 18 years old. His symptoms were about the same as the others. He lost flesh, would eat only a little rough stuff, seemed to have difficulty in swallowing corn when he tried to eat it, finally became blind and crazy and wandered off and died.

I next lost an eight-year old horse. His symptons were much like the rest. He lost his appetite and apparently starved to death. He was off feed two weeks and really sick four days. As soon as he died I put a knife into him and it seemed as though a barrel of water ran from him. There was lots of inflammation under the skin. Lungs and bowels were rotten and the stomach was packed full. I do not think there was a pint of blood in him. I turned the skin of his neck and opened the veins and the blood in them was thick and black. One of my neighbors lost a mare that I think was like this last horse; and another that was very much like my first three-year-old colt.

A number of horses have died at Running Water with symptoms very much like those shown by my horses.

PREVENTION AND TREATMENT.

So far it has been impossible to find a direct cure for crotalism. As in the case of "loco," most of the treatment must consist in endeavoring to prevent the disease obtaining a thorough hold on the animals. If hay or pasturage are found to contain the weed, stock should be watched very closely, particularly if feed begins to run short. If the animals begin to show the slightest signs of disease they should be placed where they will not have access to poisoned feed. They should be supplied with pure, nourishing, easily digestible food.

Dr. Stalker says, "Animals placed on good, green pasture, or supplied with other nutritive food, free from the poison, will doubtless make slow recovery. Two ounces of Epsom salts, with two drachms of sulphate of iron and one drachm of nux vomica, daily, will tend to restore the tone of the system and promote digestion."

As the rattlebox will not persist in cultivated land it may be gotten rid of by plowing up infested fields and seeding down to tame grasses and clovers where they will grow. The experiences of the last few years show that much is to be hoped for in this direction. Timothy, red-top, blue grass, fescue, smooth brome grass, clover, alsike, and alfalfa have been quite successfully grown in many parts of the south-eastern portion of our state.

III. ERGOT.

Throughout the greater portion of the state, a very large part of the hay is made from the wheat grasses (*Agropyrum spp.*) and the wild ryes (*Elymus spp.*). These grasses are more or less subject to a disease, due to a fungus (*Claviceps purpurea.*) This disease is called *Ergot*, and besides attacking the above mentioned grasses, it has been found on several other species growing in the state, namely, blue joint (*Calamagrostis canadensis* and *C. confinis*); reed canary grass (*Phalaris arundinacea*); Kentucky blue grass (*Poa pratensis*); Canada blue grass (*Poa compressa*), and common cultivated rye.

In other states red top and timothy have, at times, been very badly affected. For the past two years ergot has been very plentiful in various parts of the state. Of the wheat grasses, Colorado blue stem (*Agropyrum glaucum*) has suffered worst, while slender wheat grass (*Agropyrum tenerum*) has been least affected. All of the wild ryes have been more or less badly affected. In some localities the blue joint grasses and reed canary grass have suffered severely, but the occurrence of ergot on these grasses has not been so general, as in the case of the wheat grasses and wild ryes. Blue grass has not yet been so badly affected as to render it at all injurious.

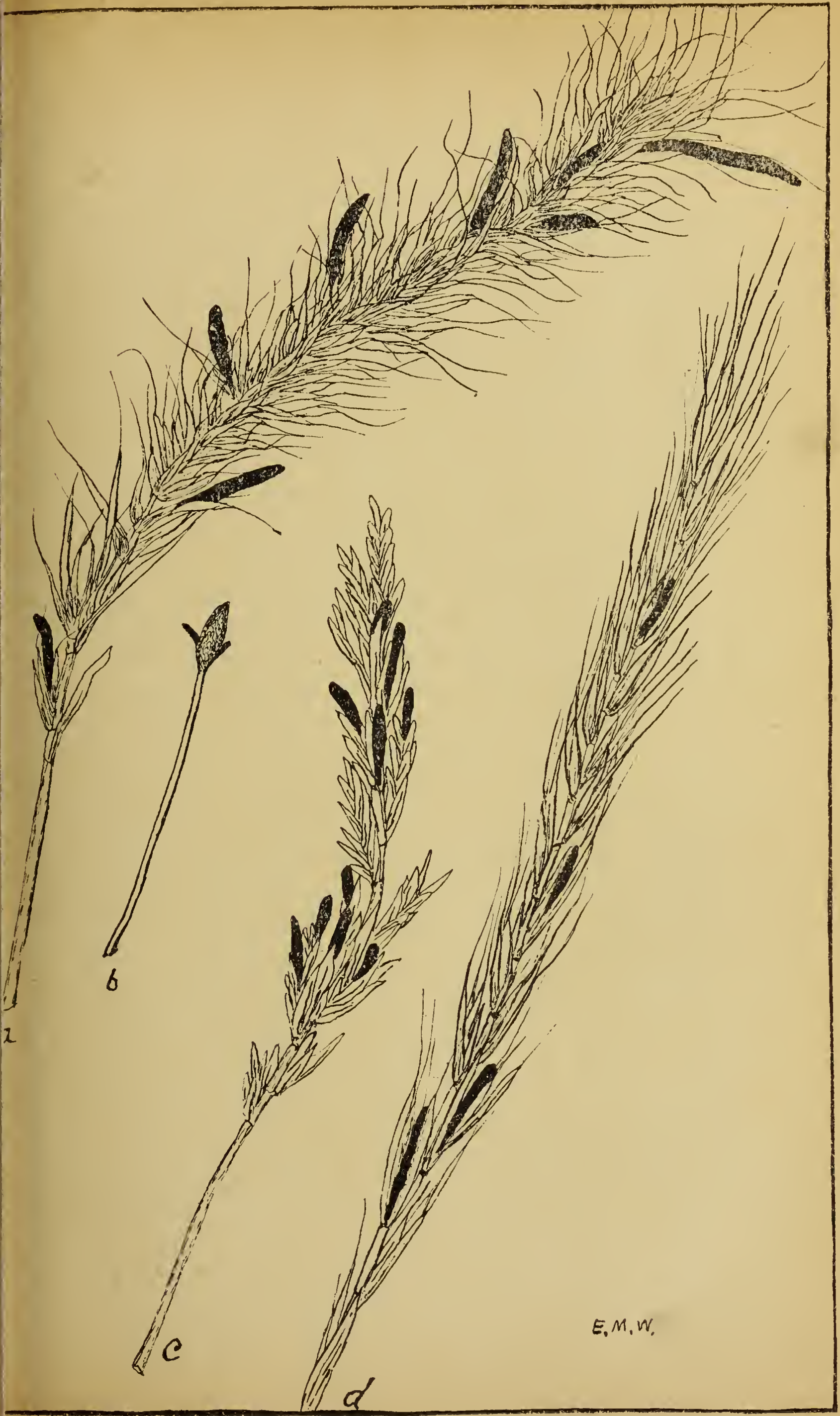

PLATE IV.

EXPLANATION TO PLATES.

Plate IV.

a. Head of wild rye (*Elymus canadensis,*) showing ergotized grains.
b. Ergot on wire rush (*Eleocharis palustris.*)
c. Ergot on wheat grass, or Colorado blue stem (*Agropyrum glaucum.*)
d. Ergot on bearded wheat grass (*Agropyrum caninum.*)

Plate V.

a. Ergot on Canadian blue-joint (*Calamagrostis canadensis.*)
b. Ergot on Northern blue-joint (*Calamagrostis confinis.*)
c. Ergot on reed canary grass (*Phalaris arundinacea.*)
d. Ergot on slender wheat grass (*Agropyrum tenerum.*)

All drawn natural size from nature.

LIFE HISTORY OF ERGOT.

Ergot first attacks the grass as a minute body or spore. This spore falls upon the young ovary, or seed of the grass, and germinates by sending out a minute thread-like body or germ tube. This tube penetrates into the tissues of the ovary, growing and branching very rapidly, until the young seed is filled with a net work of threads (*Mycelium*) of the fungus. Soon some branches of the mycelium push themselves outside the young seed and divide into many minute bodies called conidia. This is known as the *sphacelia* stage of the fungus. Now, as the wind blows the grass from side to side, these conidia are knocked off and some of them fall upon other, and perhaps unaffected ovaries, and there germinate and grow, as did the spore.

Later in the season the diseased ovaries will be found to be more or less shrivelled, and in place of a well matured ovary, a dark violet or black, hardened body is developed. This, when mature, projects from the spike, or head of grass, as a black spur-like body. It is the part of the fungus called ergot, and contains the poisonous principles which render it so injurious. This body is known as the *sclerotium* stage of the fungus, and, when mature, is dark violet, blue-black, or black, on its outer surface and whitish, often with a violet tinge, within. In the wild rye and wheat grasses it is usually from one-half to an inch or more long and about one-tenth of an inch in thickness. In blue grass, red top and timothy the ergot is usually much smaller, though with the same appearance otherwise.

Strictly speaking, the ergot is not a diseased grain, or ovary, but is developed directly beneath the ovary, which is thus pushed up by the ergot and shrivels up so that it can be seen only with difficulty upon the upper extremity of the ergot-body or sclerotium. This is the dormant stage of the fungus. It falls to the ground and during the next spring developes long stalked bodies with globular heads, called *stromata*, within which the spores are produced which start the fungus on its round of life once more.

EFFECT OF ERGOT ON STOCK.

Though all domestic animals are affected by ergot when it is fed to them, little injury occurs ordinarily, except in the case of cattle. Horses seldom get enough of it in their feed to do them much injury. This is no doubt due to the fact that they are fed a greater proportion of grain than are cattle, and to the fact that the horses have better care, as a rule. Then again, horses are usually more particular as to what they eat and usually refuse to eat ergotized hay to any extent.

The disease caused by ergot is known as *Ergotism*. The symptoms vary considerably according to the conditions surrounding the affected stock. As stock usually gets ergot in hay, only a small amount is eaten at one time, and the immediate effect is very slight; but as more ergot is eaten the disease gradually becomes worse and often gets a very firm hold on the animal before any very decided symptoms are noticed. The animals become gaunt and more or less emaciated, though having a fairly good appetite. The hair becomes rough. They usually become lame and appear to have lost all their energy.

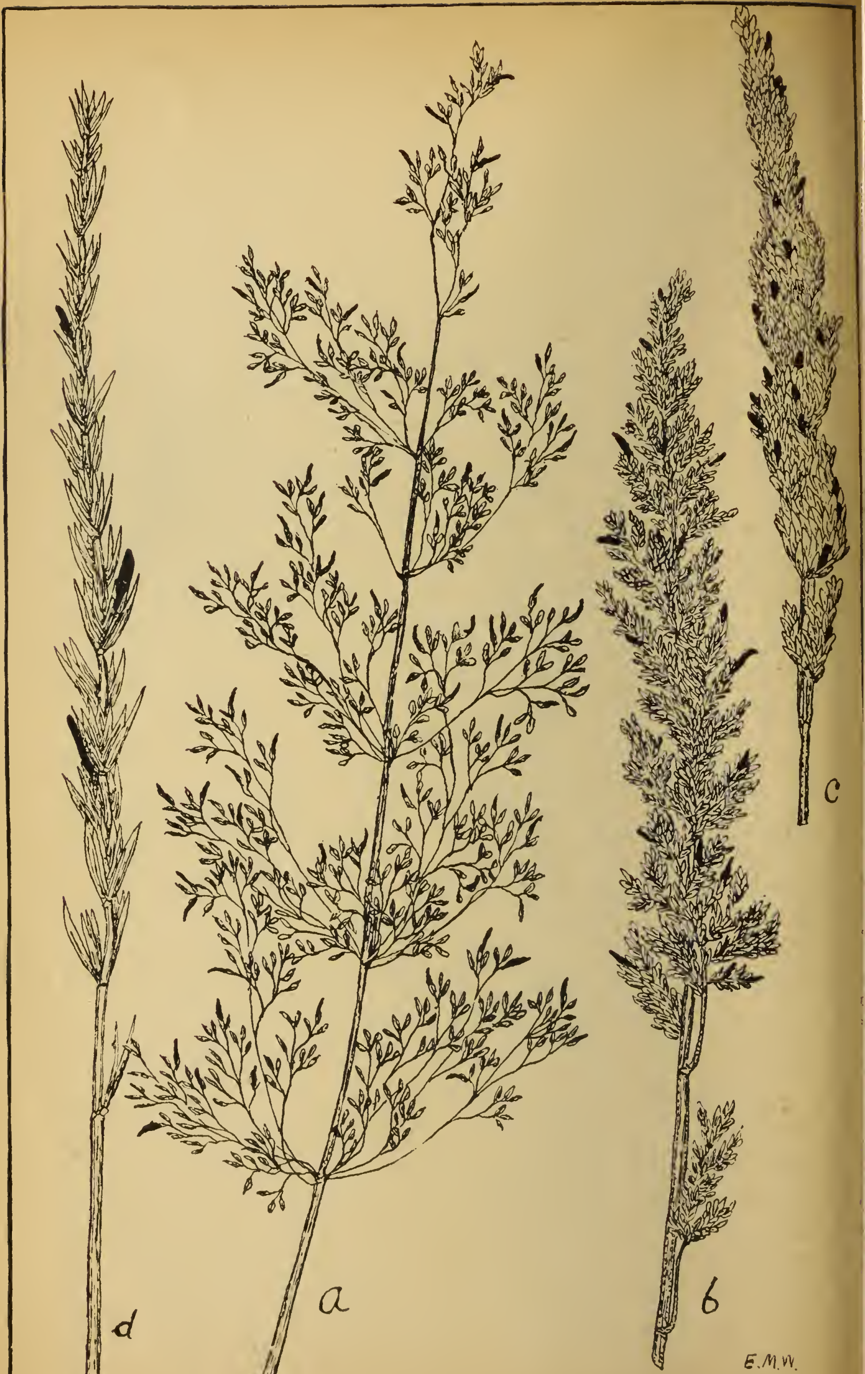

PLATE V.

There is more or less of nervousness and loss of voluntary motion. Sometimes there is loss of appetite. Very frequently there is more or less derangement of the digestive apparatus. In most cases, if the disease is allowed to proceed, the feet become cold and lifeless. Dry gangrene sets in and the flesh sloughs off, often taking the entire foot, bones and all with it. Many cases of this nature have occurred in Iowa, Kansas, Missouri and other states. Cases have occurred where the tail was also affected with gangrene. Except sometimes in the earlier stages of the disease, the temperature of the animal is about normal or a little below. Cases of abortion are usually frequent among stock affected with ergotism. The mouth is often affected, and when this occurs with the diseased feet, ergotism is often mistaken for the "Foot and mouth disease."

The poison in the ergot evidently affects the nervous centers; depresses the heart action, and so cuts off the supply of blood to the extremities and retards the process of digestion; and causes more or less of relaxation throughout the whole system.

CONDITIONS FAVORING ERGOTISM.

Scarcity of good, pure water is a very important factor.

Lack of proper shelter during cold winter weather is favorable to the disease, since the poison affects the circulation of the blood.

Stock allowed to begin the winter in poor condition are more liable to be seriously affected.

PREVENTION AND TREATMENT.

Prevention: Hay that is badly affected with ergot should not be fed to stock at all, or, if that is necessary, only in small quantities and in company with some easily digestible, nourishing and heating food. It has been observed that where stock was fed plenty of corn with ergotized hay that little if any bad effects were noticed. The corn is heating and stimulating and so overcomes to a greater or less extent the depressing effect of the poison. If but little ergot is found in the hay little if any danger is to be feared. As the ergot is formed late in the summer, or in the fall, early cutting will avoid it. Grass that is subject to ergot should, then, be cut as early in the season as possible. Many of the grasses most liable to be affected with ergot, as the wheat and wild rye grasses, make much better hay if cut early, hence, there are two important point to be gained by cutting early—better hay, and freedom from ergot. Stock in poor condition should never be fed hay affected with ergot. If it becomes necessary to feed ergotized hay the stock should be supplied with plenty of good, wholesome water and should be well sheltered and cared for. If stock appears to lose flesh, take away the affected hay altogether.

Give all stock plenty of water. Oftentimes, when the supply of water comes from ponds or streams during the extreme cold of winter, stock will drink only a minimum amount. The cold water and the exposure necessary to procure it helps along the depressing effect of the poison and hastens loss of feet or other extremities. Good shelter and proper water supply are very essential.

TREATMENT: As has been said, much more can be done by way of prevention than by treatment for the disease, after it has once obtained a good hold upon the animal.

No hay containing ergot should be fed. Give the animal plenty of warmth and good, rich, stimulating food.

At the first appearance of the disease a good dose of physic, such as epsom salts, may be given to get rid of all the poison in the stomach.

If the gangrenous sores occur they should be protected by bandages covered with some mild antiseptic dressing, as cosmoline.

SOUTH DAKOTA
AGRICULTURAL COLLEGE
AND
EXPERIMENT STATION
BROOKINGS, S. D.

BULLETIN NO. 34.

APRIL 1893.

Chemistry.

THE SUGAR BEET.

DUTCHER, BREED & STORGAARD, BROOKINGS.

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The Bulletins of this Station will be sent free to all citizens of the State who will apply for them.

All letters and other mail matter for the Station should be addressed to the Experiment Station.

THE SUGAR BEET.

Jas. H. Shepard, Chemist.

WORK AT THE EXPERIMENT STATION.

Sugar Beets From Home Grown Seed.—Of the six varieties of mother beets planted from seed, three varieties were lost after the seed had fully matured. These beets were planted on the station farm and were destroyed by sheep. The remaining three varieties were planted in my own private garden and the seed obtained were sown last spring. The names of these varieties are Dieppe's Klein Wanzlebener, Pajaro Valley, and Simon Legrand's White Improved.

As already reported in Bulletin No. 27 of this Station the three mother beets selected of the variety Klein Wanzlebener gave respectively 15.70, 17.40, and 15.61 per cent. sugar in the beet after storing in the farm barn celler until May 11-14.

The two Pajaro Valley mother beets selected gave 15.31 and 15.51 per cent. sugar in the beet under like conditions. The two Simon Legrand mother beets gave 15.11 and 15.61 per cent sugar in the beet under the same conditions.

These percentages are here repeated in order that a comparison between the sugar content of the mother beets and that of their offspring can be more conveniently made.

Owing to the cold and rainy weather during the spring these beets did not germinate until the last of May although the seed was sown April 29. The ground selected for the trial was chosen from the Horticultural garden and was a dark sandy loam situated rather high and sloping towards the east. The rows were 22 inches apart and ran north and south. Before the beets came up a crust was formed over the ground by the hot sun and this crust was broken by means of a garden rake. Nearly a full stand of beets was obtained. The few breaks which did occur in the rows were caused by the extraordinarily heavy rain which fell in the fore part of May. Streams of water ran across the rows and washed some of the seed out of ground and carried it away notwithstanding the fact that the seed was planted at least two inches deep by means of a garden hand drill.

The seed bed was made by plowing the ground twelve inches deep early in the spring after which it was firmed by repeated dragging. No subsoil plow was used in order that the conditions might be as near like those under which the mother beets were raised. No fertilizer was employed nor had any been used on the plat for the past two years. Corn was the last crop grown.

The beets were first cultivated with a hand cultivator after which they were hoed and thinned by hand to 5 inches in the row. They were subsequently cultivated and hoed twice. The beets of all three varieties were well formed and free from disease and the appended analysis show that for sugar making purposes they were first class in every respect. In column 1 is given the analysis of the Klein Wanzlebener variety. In column 2 that of the Pajaro Valley and in 3 and 4 that of the Simon Legrand. All these analyses were made on Aug. 25, excepting the last which was made Aug. 26. In each analysis six beets were used.

	(1)	(2)	(3)	(4)
Station No.	389	388	390	420
Weight of beets in grams	329	282	253	296
Sugar in beet, per cent	18.70	15.50	18.20	18.10
Sugar in juice, per cent	19.66	16.23	19.27	19.11
Degree Brix	20.00	19.00	21.30	20.10
Purity coefficient	98.30	85.42	90.46	95.07
Ash in juice, per cent	.76	.70	.43	.59
Marc, per cent	4.91	4.48	5.54	5.28
Tons beets per acre	18	19.5	18	.....

From an inspection of the foregoing analyses and from a comparison of the sugar content of the mother beets with that of their progeny it will appear that after making due allowance for the unavoidable loss in storing the mother beets, the beets grown from home seed have retained their high standard; and that in case the sugar industry should become established in our midst it would be unnecessary for us to rely upon foreign importations for our supply of seed. Enough of each variety of these beets to raise seed for one half acre were carefully packed in dirt and stored in the green house cellar, but owing to the gross carelessness of an employee of the Station they were fed to stock and thus much valuable time has been lost.

Importation of Seed.—In view of the fact that pedigreed and carefully grown seed is one of the first requisites of successful sugar beet growing, the Station Council voted to import two sacks of the best seed obtainable. Accordingly arrangements were made with Messrs. August Roelker & Sons, 136 & 138 W. 24th St., New York, whereby this Station secured direct from the grower, August Knoche, one sack each, weighing about 110 pounds per sack, of that celebrrated grower's strain of the Klein Wanzlenener and Vilmorin types. The sacks were received at this Station with their leaden seals intact and inside of each sack was a tag placed there by the grower. In the Vilmorin sack the grower's tag was marked "No. 1. *Zuckerrueben Samen Knoche's Verbesserte Zuckerreichste Elite, eigene Zuchtung Aug. Knoche, Wallwitz B. Halle a. s.*" In the Klein Wanzlebener sack the tag bore the same legend except the grower's name for the variety, "*Knoche's Verbasserte Klein Wanzlebener Elite.*" These varieties will be referred to hereafter simply as of the Vilmorin and Klein Wanzlebener types deeming the foregoing explanation as to the origin of the seed sufficiently explicit.

The sugar beet seed thus obtained was distributed to farmers throughout the state. But in order to test this seed beside that grown at this Station a trial plat of each kind was sown immediately beside those previously described in the Horticultural garden and the same treatment was given to all. Consequently the analyses will complete the report.

In the following table are given the analyses of both varieties. Columns 1, 2, and 3 show separate analyses of the Klein Wanzleben variety made respectively on October 13, 18, and 25.

	(1)	(2)	(3)	(4)
Station No.	382	383	387	386
Average weight of beets in grams	346	406	322	378
Sugar in beets, per cent	15.40	15.60	15.50	15.30
Sugar in juice, per cent	16.20	16.25	16.15	16.09
Degree Brix	17.20	17.70	19.40	21.00
Purity coefficient	94.20	91.80	83.25	76.66
Ash in juice, per cent	.86	.84	.88	.81
Marc	4.92	3.97	4.35	4.92
Tons per acre	23.5	.....	.....	19

From even a cursory inspection of the foregoing analyses it will appear that these varieties gave good results with some advantage in favor of the Klein Wanzlebener type.

DISTRIBUTION OF SEED.—In the preceding bulletin on sugar beets the announcement was made that seed would be sent to those farmers who applied for it and who would promise to follow directions for cultivation. But the number of applicants who could be furnished with seed would be limited to the first four hundred who applied. Something over four hundred applications were received and as promised four hundred samples of seed were distributed. With each sample sent out was enclosed the following circular of instructions:

BROOKINGS, S. D. March, 1892.

"DEAR SIR:—

Within you will find a sample of the best imported Sugar Beet seed, variety.............. This seed is sent out by this Station for the purpose of ascertaining if our state is well adapted to the successful culture of beets sufficiently rich in sugar to warrant the establishing of sugar beet factories as a permanent industry among us.

Over, you will find explicit directions for Sugar Beet culture and you are earnestly urged to follow the directions exactly. All the points noticed are essential and none of them can be safely neglected.

Next fall directions for taking samples of beets for analysis will be sent you in due time. Please do not harvest the beets nor send samples until you receive notice from this Station.

At the time notice is sent a blank, calling for some important information, which you alone can give, will also be sent. Therefore, if you will kindly put down the exact date when the beets are sown and also note from month to month what the prevailing weather for each month during the growing season is, you will be able to fill out the blank correctly in a few minutes time.

Do not mix these seeds with any other variety."

DIRECTIONS FOR BEET CULTURE.

1. "SELECTION OF SOIL.—Choose rather high sandy soil which has not been manured since the last crop was taken off. Also do not apply any fertilizers this year.

2. PREPARATION OF SEED BED.—Having selected the ground to be used, measure off a plat one rod wide and four rods long; or you may take a plat two rods square. This will give you one fortieth of an acre. Now plow the ground deep, at least twelve inches. Then by means of much dragging, or by means of a roller or plank, make a good, firm seed bed of finely pulverized earth.

3. SOWING THE SEED.—Now lay off on the prepared seed bed rows exactly 22 inches apart. There will be nine rows if the plat is one rod wide, or eighteen rows if it is two rods wide. sow the seed the last week in April or the first week in May, according to the weather. Do not fail to get the seed in this early. Plant the seed from one to two and one-half inches deep depending upon the dampness of the ground. The seed must be in damp earth. The seed may be sown by hand or a garden drill may be used. There is just enough seed in the accompanying package to sow the plat as prepared. Use all the seed on one plat, so the young plants may come up thickly. If the ground is dry at time of seeding it will be well to soak the seed twelve hours before planting, but they must not be allowed to sour or ferment, as this will spoil the seed.

4. THINNING AND CULTIVATION.—When the young plants have four to six leaves, go over the plat with a hoe, hoeing close to the rows. Now go over each row by hand, thinning out the beets so that the plants may stand from four to six inches apart. Also remove all the weeds. From this time on the beets may be cultivated by hoe or horse cultivator to keep free from weeds and to keep the soil mellow. The beets are not to be exactly hilled up, but it is best to work the soil towards the beets. The ground must not be allowed to crust over or to cake and crack."

Arrangements were also made to have two acres of sugar beets raised, one on the Station farm and one on the farm of Hon. D. W. Diggs of Milbank. The object of this was to ascertain the actual cost of producing the beets under existing circumstances. But the floods which fell in the early part of May nearly ruined both plats. It seems that both plats were on gently sloping ground and the water washed the seed away. In both cases the cost of production would more than exceed the value of the beets raised.

Owing to the fact that the heavy cold rains in May were followed by clear hot weather the sugar beet plats were soon crusted over to such an extent that it was difficult for the young plants to break through the soil. Under the circumstances it was deemed best to issue a Press Bulletin and give supplementary advice in regard to the treatment of the plats. The Bulletin follows:

SUGAR BEETS.

"It is now time that the various plats of sugar beets throughout the state were thinned and hoed and the ground put in the best possible condition for the growth of the young plants. The thinning may be expedited by hoeing first as close to the row as possible. Then it is absolutely necessary that each row should be gone over separately by hand. The beets are now all to be removed excepting enough to give one plant every four to six inches. In leaving the plants it should always be the aim to leave the thriftiest and most vigorous growers. Great care must be taken that two plants are not left growing side by side, as it often occurs that two plants will grow up together and appear as only one. If they are both left neither will reach perfection.

The late and cold rains during the season have been unfavorable to the beet crop, not only in this state but everywhere. From France, Germany and Russia the same backward condition is reported. The germination of the seed was much delayed by cold rains and in some places where the ground was slightly sloping some of the seed was washed out while other portions were buried too deep. But what was worst of all was the crust that formed over the ground. By digging through the crust the young plants would be found growing around and around in a spiral seeking to emerge into the air above. Any little crack that would afford egress was diligently sought for by the tiny plant struggling to free itself. This was a severe strain on the plant even though it finally did succeed in coming through. Its vital forces were much awakened. But this same state of affairs is reported everywhere.

The stand in many cases will be irregular. But it does not make any difference about the necessity for thinning. All bunches in these irregular rows must be thinned just as carefully as in full rows.

A little good careful work now with the experimental plats will go far towards making up for the late spring. The ground must be kept mellow and this will go far toward removing the coldness of the soil. Neither must the weeds be allowed to choke out or even to shade the young plants. The beet delights in the sun shine, therefore the ground must be kept clean,

It is probable that the beets will be late in ripening this fall, but as soon as they begin to approach maturity analyses will be made and ample warning will be sent to all growers in the state. One bad mistake in the past year has been made in sending in immature samples. When the sugar beet has made its growth it still needs to stand in the warm sunny ground in order to finish the process of making sugar. There is not much sugar in the beet when it is growing. The sugar is made after growing has ceased. The last few days in the fall are worth more than a month at any other time.

Growers are, therefore, cautioned not to harvest their beets until they receive notice from this Station. Give the plats good care and we may still reach good results."

Notwithstanding the unfavorable out look early in the season the summer and fall proved favorable for the growth of the sugar beet and better results than could have been expected were obtained. The warm dry, bright weather which prevails during the fall months in this climate is most favorable to the ripening of the sugar beet. As a rule damaging frosts do not occur until about the middle of November. The lighter and earlier frosts scarcely seem to effect the tops of the sugar beets. One suggestion however might be useful in this connection and that is low growing varieties of beets that make their growth completely under ground will be found best adapted to this dry climate. Moreover the later hoeing and cultivations should be so carried on as to work the dirt toward the beets in order to protect the crowns from the bright sun and from any of the earlier frosts. The sugar beets that were saved for seed at this Station were not harvested until the 10th of November. The beets had been ripe for nearly thirty days.

As soon as the beets reached maturity directions for sampling and shipping were sent as follows:

DIRECTIONS FOR TAKING SAMPLE OF SUGAR BEETS FOR ANALYSIS.

"Select an average row, one of the inside rows is best. Measure off exactly 23 feet and 9 inches on that row and harvest all the beets in the distance measured. If so long a piece cannot be found in one row it may be partly taken from two or more rows.

Cut off the tops of the beets and wash the beets. As soon as dry weigh them and divide the weight in pounds by 2. The result will be the tons per acre. This calculation is based on the supposition that you have planted the rows 22 inches apart as instructed. In case you have made the rows a different width you cannot get the tons per acre by dividing by 2. In such case, follow the foregoing directions, (and give the width of rows,) but leave the computation for us to make.

A pair of steelyards or a spring balance will answer for weighing the beets if no scales are handy.

Select five average sized beets, wrap each one in a paper and place them in a sack. Now fill out the blank on the other side of this sheet, place it in an envelope and place in the sack with the beets. Tie up the sack, attach the enclosed shipping tag and forward to us by express. We will pay the express charges.

N. B.—Do not send the largest beets you have raised as they are not fit for sugar making. Do not send the smallest as they are not ripe. Send *average* sized and perfect beets. The best beets for sugar making weigh from three quarters of a pound to a pound and a half. If any beets grew seed stalks do not send them for analysis."

About the usual per cent. of experimenters reported and returned samples. But one thing is noteworty, and that is, very few who reported and did not return samples gave as a reason therefore a failure of the crop. Stock destroyed some plats, the heavy rains washed out a very few, some were neglected and some growers were too busy to attend to sampling the beets and others forgot all about them.

The samples on an average were taken with greater care than in previous years, but some clinging to the delusive belief that the largest beets were the best, and in spite of the explicit instructions given, sent the largest beets raised, beets that evidently came from the ends of rows or from thin places in the row.

On the whole the results obtained are satisfactory. The season could not be called better than the average and after due deliberation the Station council voted to discontinue further work in the state and this action was approved by the Board of Trustees.

EXPERIMENTS THROUGHOUT THE STATE.

For the same reasons assigned in the last Sugar Beet Bulletin the state is divided into four regions:

The Big Sioux Vallex and Eastern Region embraces all that portion of the state east of the eastern water shed of the James river.

The James River Valley Region is a well marked district most of which is situated over the artesian basin in South Dakota. This region has many advantages for sugar beet culture.

The Missouri River Region extends from the western water shed of the James river to the Missouri river. The tier of countries west of the river are but sparsely inhabited toward the northern portion of the state.

The Black Hills Region, as is well known, embraces the rich mining regions of western South Dakota. There are many fertile valleys and level plateaus throughout this region where farming is carried on; and it is from these places that the samples of this year have come.

THE BIG SIOUX VALLEY AND EASTERN REGION.

Ninety four samples of seed were distributed to this region.

The following notes have been gleaned from the reports sent in by experimenters.

MARSHALL COUNTY:—Six packages of seed were sent to this county and two samples of beets were returned. Mr. Linse reports that the soil was heavy and was manured a year before the beets were sown. Mr. Blackman used light sandy soil with no fertilizer. May and June were wet and cold. July was rainy, August was hot and dry, some local rains in September and October was dry until the 12 when it rained two days.

ROBERTS COUNTY:—Three samples were sent to this county and none of them have been heard from.

DAY COUNTY:—Nineteen samples of seed were sent to this county and seven returned beets. May was wet and cold; June warmer with heavy showers; July plenty of rain; August warm and dry; September warm and dry; October dry and cool, hard frost the 20th. Mrs. Resseguie sowed the seed in black loam and the beets grew very large. Mr. Atkins sowed on clayey land with no fertilizer; a fine stand reported. Mr. Sanders sowed on prairie loam that had been fertilized in 1891 with stable manure; many beets grew large, one of the largest weighing 10 pounds. Mr. Heydlauff used black loam ten inches deep with yellow clay subsoil; manured the previous year. Mr. Johnson used black sandy loam. He divided his seed and sowed part on old ground and part on new. (456) Mr. Lewis sowed on black loam never fertilized and reports plenty of rain all the season. Mr. Reed used sandy black loam never fertilized. Beets came up thin and poor owing to cold weather.

GRANT COUNTY:—Twenty one samples of seed were sent out to this county and nine experimenters returned beets. May was cold and rainy, rainfall 8.8 in. beets washed out, June much rain, temperature ranging from 41 to 58 min. and 59 to 83 max. rainfall 3.3 inches. July total rain 3.80 tem. 48 to 68 min., 70 to 94 max. August total rain 6.66 in. tem. 40 to 64 min. 56 to 92 max. September first part rainy, lastly dry and warm. October dry and warm.

Mr. Ferry selected a black loam with little sand. The land became hard and lumpy owing to the rain. Mr. Diggs selected a black loam on a sloping piece of ground. He had kindly consented to raise one acre for the purpose of determining the cost. But the beets washed out. He had some transplanted, but the cost of raising far exceeded the income of the beets.

Mr. Armstrong used new land only cropped once previously. Mr. Kelley planted on black loam with clay subsoil. Mr. Johnson used a piece of old garden land, sandy loam. Mr. Priest planted on black loam and had a good stand in spite of the fact that the ground became hard. Mr. Lloyd planted on new ground which had one crop of potatoes previously. Mr. Holloway used slightly rolling ground. Mr. Hicks planted on sandy loam and beets germinated well.

CODINGTON COUNTY:—Four samples of seed were sent to this county and only one man reported. Mr. Skogstad planted on high prairie and his beets did not germinate well owing to a heavy rain right after planting. He reports the weather substantially as from the preceding county except frost in the latter part of October.

DEUEL COUNTY:—Mr. Comport was the only applicant for seed from this county he planted on black loam with clay subsoil. The plat was part of a garden that had been manured with stable manure for the past eleven years. Although the garden was on rising ground it was submerged three times with heavy rain. Weather similar to preceding county. Sharp frosts Oct. 19, 20 and 21. He states that at least five per cent of beets grew prongy which he attributes to deteriorated seed. The real cause was that his ground was not plowed deep enough and properly pulverized.

HAMLIN COUNTY:—Five samples of seed were distributed in this county and three samples of beets were returned. Mr. Jardine sowed the seed on upland with surface soil two feet deep. Beets came up uneven on account of cold wet weather. The weather report for this county was similar to that of last county. Mr. Walker planted on black loam manured the previous year. Mr. Payne used rolling upland which had been in oats the previous year.

BROOKINGS COUNTY: Ten samples of seed were sent to this county and eight experimenters returned beets for analysis. The Station Farm plat covered one acre. It was plowed eight inches deep and subsoiled four or five inches. The ground was well prepared and was on a slightly sloping piece of land facing the north. Owing to the cold wet weather the seed was not sown until the 16th, of May, on the 17 a heavy rain exceeding two inches fell within the space of about one hour, The water rushed down the slope and carried the seed of some rows away and cut the piece into deep gullies. The intention was to raise this acre of beets just as would obtain in actual practice. The heavy rain spoiled the experiment.

The weather for this county was similar to that of the last mentioned. Mr. Devan used sandy loam without fertilizers. Cattle ate the tops of the beets in September and damaged the plat otherwise. Mr. Hendrikson used summer fallow of the previous year, plowing again in the spring and the piece was never fertilized. Mr. Pike planted on sandy loam sloping to the south. The directions were carefully followed. Mr. Quinlan sowed on a rich loam but his beets stood so far apart that the results were poor. Mr. Sundt planted on sandy soil manured the year before and plowed in the fall. The directions were followed and the results were good. Mr. Honan used a sandy, gravelly loam manured the previous year with stable manure. Mr. Pool used black loam plowed very deep and not manured for two years.

LAKE COUNTY:—Eleven samples of seed were sent to this county and four experimenters returned beets for analysis. The weather reported is for May first half dry, second half frequent showers. June frequent showers. July quite dry, a few showers. August hot and dry and September the same. October dry.

Mr. Rankin used black loamy land between two rows of trees that had been mulched five years ago. The beets were not shaded. Mr. Huyzer used black loam very sandy, heavily manured in 88 and 90. The beets were damaged about ten per cent by cut worms. Dr. Jones used black loam with a little sand in it. Used stable manure the year before and planted to potatoes. The beets were rough being affected with a species of scab. Mr. Whitmore used horse manure on the land the previous year.

MOODY COUNTY:—Two samples of seed were sent to this county and one sample of beets was returned. Mr. Haskins sowed on upland fertilized the previous year with fresh barn yard manure and planted to corn. He reports the weather about the same as in the preceding county except more rain in May.

MINNEHAHA COUNTY:—Six samples of seed were sent to this county and two samples of beets were returned. Weather reported similar to last excepting many frosts in October. Mr. Grant planted on common prairie soil and the first sowing was partly washed out. A second sowing was made on the 22. Mr. Oleson planted on sandy loam and his stand was irregular in the rows, the single beets often standing thirty inches apart.

McCOOK COUNTY:—Mr. Patheol was the only applicant for seed from this county whose application came in time. He planted on upland and thinks the crop is easily raised in his county.

LINCOLN COUNTY:—Four packages of seed were sent to this county and two samples of beets were returned. The weather reports are the same as in last county no mention being made of frosts in October. Mr. Myhre sowed on sandy loam and reports that most of his beets weigh three pounds each. Mr. Olin also sowed on sandy loam and reports that his beets grew very large many weighing six pounds.

The following tables complete the reports for this whole region. Under the heading, "variety" the letters K and V are used to denote respectively the Kleinwanzlebener and Vilmorin types as previously explained. Under the heading "pounds sugar per acre" is given the total pounds sucrose raised. It does not follow that that many pounds would be extracted at the factory. Much depends upon the processes used and upon how skillfully the operations are conducted:

Station No.	Variety.	Grower.	Planted.	Harvested.	Rows—inches.	Beets in Row—inches.	Tons per Acre.	Number Beets Analyzed.	Av. Weight—grams.	Per c't. Sugar in Beets.	Per c't. Sugar in Juice.	Degrees Brix.	Purity Coefficient.	Per cent. Ash in Juice.	Per cent. Marc in Beets.	Pounds Sugar per Acre.
		MARSHALL COUNTY—														
539	K	L. E. Blackman	May 1	Nov 1	22	7	10	5	320	17.57	18.50	22.60	81.42	....	5.00	3514
535	K	H. R. Linse	Apr 28	O't 28	20	4	10	5	470	14.60	15.40	21.00	70.00	....	5.00	2920
		DAY COUNTY—														
437	K	Mrs. S. Resseguie	May 27	O't 21	36	8	....	5	453	10.70	11.17	16.50	67.70	1.22	4.22	.....
445	V	H. A. Atkins	May 16	O't 28	22	5	27	5	510	13.25	13.84	18.00	76.89	1.07	4.31	7155
449	K	N. Sanders	"	O't 25	22	6	45	4	830	13.20	13.71	18.10	75.75	1.38	3.74	11880
452	K	H. J. Heydlauff	May 12	O't 28	22	5	20	5	582	13.90	14.57	19.10	76.28	1.14	4.60	5560
455	K	T. E. Johnson	May 10	O't 29	20	5	14.3	3	544	15.00	15.72	18.60	84.52	1.12	4.55	4292
456	K	"	"	"	20	5	14.3	3	390	14.65	15.38	18.40	83.59	1.30	4.79	.....
494	V	L. W. Lewis	....	O't 26	22	....	....	4	479	13.10	13.73	17·20	79.83	1.01	4.62	.....
528	K	S. J. Reed	May 9	O't 28	24	....	17	5	629	11.50	12.00	15.80	76.00	.85	4.20	3910
		GRANT COUNTY—														
399	K	W. H. Ferry	May 24	O't 21	20	6	18	5	404	16.50	17,35	20.50	84.64	.98	4.92	5940
401	K	D. W. Diggs	May 2	O't 22	22	4	28	4	751	15.20	15.89	18.50	85.89	1.11	4.37	8512
434	K	W. F. Armstrong	May 12	O't 20	22	....	....	4	735	15.20	15.87	17.80	89.16	1.01	4.24	.....
459	V	Edgar Kelly	....	......	....	....	....	4	713	10.80	11.23	15.60	71.99	1.52	3.87	.....
465	V	Nels Johnson	May 6	O't 28	22	18	12.5	4	914	15.60	16.29	17.40	93.62	1.20	4.23	3900
478	K	J. V. Priest	June 3	O't 24	22	7	40	4	713	10.30	10.68	14.90	71.68	1.59	3.55	8240
517	V	F. P. Lloyd	May 15	Nov 3	44	12	....	4	1125	14.30	14.90	17.00	87.60	.72	3.97	.....
526	K	Wm. Halloway	May 16	Nov 5	22	6	32	4	610	14.00	14.60	18.20	80.20	.98	4.28	8960
540	V	Jno. Hicks	May 4	N'v 10	22	6	30	5	520	17.20	18.10	19.20	94.80	....	5.00	10320
		CODINGTON COUNTY—														
443	K	N. A. Skogstad	May 12	O't 25	22	6	15	5	574	11.90	12.42	16.20	76.66	1.23	4.19	3578
		DEUEL COUNTY—														
397	K	Thos. Comport	May 25	O't 21	22	10	10.5	4	724	14.60	15.35	19.00	80.79	1.19	4.89	3066

		HAMLIN COUNTY—														
496	K	John Jardine	May 10	O't 26	22	6	32	4	703	12.25	12.74	16.00	79.65	.98	3.85	7840
512	V	B. W. Walker	Apr 30	" 24	22	8	12	5	456	16.50	17.40	20.00	87.00	.82	5.40	4000
527	K	R. T. Payne	June 8	Nov 2	48	8	17	5	386	11.80	12.30	15.80	78.00	1.01	4.23	4010
		BROOKINGS COUNTY—														
384	V	Station Farm	May 16	O't 19	22	5	19	5	374	13.00	13.58	16.53	82.15	.86	4.30	4940
384	V	" "	" 16	" 25	22	5	19	6	175	14.50	15.41	22.00	70.05	.60	5.80	4940
384	V	" "	" 16	" 27	22	5	19	6	309	14.70	15.51	17.40	89.14	1.05	5.22	4940
391	K	R. P. Devan	Apr 28	" 20	22	6	38	5	443	14.50	15.13	16.00	94.56	1.03	4.18	11020
398	V	H. Hendrickson	" 26	" 24	22	6	20	3	490	14.90	15.61	18.60	83.92	.90	4.54	5960
406	V	J. S. Pike	" 30	" 24	22	5	32	5	628	12.30	12.85	17.00	75.50	1.25	4.29	7872
408	K	M. Quinlan	May 18	" 22	44	12	15	3	933	10.20	10.63	14.50	73.31	1.38	4.04	3060
448	K	O. J. Sundt	" 7	" 28	22	6	32	4	630	13.20	13.76	18.80	73.19	1.52	4.10	8448
484	V	M. Honan	" 16	" 29	22	4	40	4	638	14.50	15.15	19.00	79.74	.95	4.31	11600
485	V	Z. Pool	June 1	" 20	18	8	....	3	1080	9.40	9.74	14.40	67.64	1.34	3.49	.....
		LAKE COUNTY—														
415	K	J. R. Jones	May 15	" 24	18	4	46	5	536	13.20	13.80	17.30	80.00	1.13	4.33	12092
463	K	A. L. Rankin	" 2	" 28	22	5	20	5	542	13.70	14.28	18.00	79.33	1.53	4.06	5549
492	V	J. S. Hyzer	" 18	" 26	46	8	15	8	662	14.55	15.19	19.30	78.70	1.20	4.19	4365
533	V	Wm. Whitmore	" 20	" 22	30	4	22	5	631	14.65	15.50	18.90	82.00	1.08	5.36	6446
		MOODY COUNTY—														
440	V	E. S. Haskins	Apr 28	" 18	28	....	....	4	891	13.35	14.00	18.20	76.92	1.13	4.64	.....
		MINNEHAHA COUNTY—														
431	K	G. A. Grant	May 17	" 22	24	6	25	4	631	15.50	16.27	19.00	85.63	1.22	4.77	7750
504	V	Olaf Olson	" 15	" 19	22	....	19	3	1099	9.50	9.90	13.00	76.00	1.59	3.62	3800
		MCCOOK COUNTY—														
461	K	A. C. Patheal	" 1	" 29	22	5	29	5	575	13.00	13.54	16.80	81.19	1.09	4.00	5200
		LINCOLN COUNTY—														
470	K	Anthony Myhre	....	Nov 4	....	10	....	5	646	16.50	17.32	19.50	88.82	.93	4.72	.....
479	V	Jas. Olin	May 20	O't 22	18	5	54	3	827	15.50	16.13	18.20	88.90	.98	4.24	16740

THE JAMES RIVER VALLEY REGION.

BROWN COUNTY:—Thirty nine samples of seed were distributed in this county and twelve samples of beets were returned. The weather is reported, May cold and wet; June, first part cold with heavy rains, balance favorable; July, very dry and hot; August, warm with plenty of showers; September, fairly warm and dry; October, first part very warm with frosts in latter part.

Mr. Fulker planted on black loam with some clay in soil. Mr. Narregang planted on black loam and he sends in the best sample from this country. Mr. Hansen planted on high sandy loam. The beets were not properly thinned out. A heavy wind storm in June drifted sand over many of the young plants which received no farther attention. Mr. Webber planted on black loam that was too low for the wet weather. Mr. Matteson planted on black loam with clay subsoil plowed ten inches deep. Mr. Vetter planted on black loam and the wet weather interfered with the cultivation of the beets. Mr. Miller planted on creek bottom. Mr. Coburn planted on light sandy soil fertilized with stable manure and plowed under May 10. Mr. Edson planted on black prairie loam a little sandy in character. The cold wet weather interfered with germination. Mr. Crockard used sandy loam with no fertilizers Mr. Moody planted in black loam which had been used for a garden four or five years. In August the long legged potato bug destroyed the tops of the beets. New tops were immediately thrown out but this so delayed the ripening of the beets that the per cent of sugar was low at the time of harvesting. Mr. Svarstad used no fertilizers.

MCPHERSON COUNTY:—Only two applications for seed were received from this county and one sample of beets was returned. Mr. Reid planted on sandy loam and although his beets were not large they were exceptionally fine for sugar making.

EDMUNDS COUNTY:—Eighteen packages of seed were sent to this county and five samples of beets were returned.

The weather reports are the same as from Brown County, frosts occurring after the 18 of October. Col. Brown planted on black sandy loam so level that at times the beets were covered with water. Mr. Dickinson planted on sandy loam and used no fertilizer. Mr. Bergman planted on black loam. Mr. Bakkegard planted in good deep soil and does not understand why the beets did not grow longer and larger. He had a very fine lot of beets for sugar making and the beets grew just as they should have grown. Mr. Hilton planted on black loam between gravel knolls and had a fine even stand all over the plat.

FAULK COUNTY:—Eight packages of seeds were sent to this county and three samples of beets were returned. The weather reports are similar to the foregoing with the exception that hail is reported for July 20.

Dr. Wentworth planted both varieties of beets sent to him on dark sandy loam and used no fertilizer. Mr Thompson planted on black sandy loam that was manured four years ago. On the 20 of July hail cut off all the tops of the beets but new ones immediately grew and from the final results it will be seen that the sugar beet is a hardy plant.

SPINK COUNTY:—Eighteen samples of seeds were sent to this county and nine samples of beets were returned. The weather reports are the same as in Brown county.

Mr. Else planted on creek bottom sandy land and used no fertilizer. Mr. Sander planted on black loam and the beets grew rather small. Mr. Perkins planted on sandy loam which had the wash of the barn yard. On the tenth of June a heavy rain fell accompanied with hail which destroyed many of the little plants.

Mr. Thomas planted on sandy loam and used no fertilizer. Mr. Brunn planted on black loam beside mangels and his beets grew too large owing to the great width of the rows. Many beets weighed from 8 to 9¾ pounds each. Those sent were under medium size. Mr. Bingham used black prairie soil with no fertilizer. He planted too far apart and in the rows the beets stood from six to thirty inches apart.

Mr. Carrier planted on a plot of ground that was just on the brow of a run and the soil was considered to be of a poor quality as it washed into the run. The beets came up finely but as now storm three weeks after planting killed about three fourths of the young plants. These were replaced by transplanting when the crop was thinned thus securing almost a perfect stand. The The subsoil was gravelly and the beets grew long and perfect, some being two feet in length. Mr. Wilson sowed both varieties on light prairie soil and the stand was rather uneven. He thinks the Vilmorin strain would yield six times as much per acre as the other variety.

Clark County:—Sixteen samples of seed were sent to this county and six packages of beets were returned. The weather report is about the same as for the other counties of this region. Mr. Westover planted on black loam that was not plowed deep enough nor was it sufficiently pulverized. The ground became packed very hard. Mr. Waterman planted on black prairie loam. He asks why the seed is sown so thickly and then more than three fourths of the plants afterwards pulled up. The reason for this is, it is absolutely necessary to have a full stand of beets in order to produce the best beets for sugar making. If the beets are too far apart they grow too gross and they take up so much mineral matter that a large proportion of the sugar in them will not crystalize out in the process of manufacture and the non sugars also accumulate and tend toward the same result. Sowing the seed thickly provides against accident and insures enough plants to make a full stand. Mr. Peterson used rich black soil sloping toward the south. Mrs. Schulz used high sandy soil and the poor results given in the analysis are unaccountable unless the beets grew new leaves late. Mr. Howey planted on gravelly loam which was plowed too shallow. Mr. Weston planted on heavy clay loam which was sloping. The heavy rains washed the seed down into the bordering ditch and the stand was too thin in many places. In these places the beets grew to an enormous size.

Hand County:—Six packages of seed and two samples of beets make the report for this county. The weather is reported as before noticed. Mr. Pash planted on sandy loam and used no fertilizer. Mr. Jones used upland that was loose and mellow.

Beadle County:—Nine packages of seed were sent to this county and four samples of beets were received. The weather report is like that of the preceding county.
Mr. Fuller planted on sandy loam that was fertilized last year. Beets made second growth in September. Mr. Keator planted on black loam and his beets grew large and scabby. Beets made new tops in October which accounts for low per cent of sugar. Mr. Campbell planted on black loam not fertilized and had a fine stand of beets. Mr. Sprague planted on dark sandy loam. Beets made but little growth in July. Mr. Howell sent his beets to the express office but the agent neglected to send them and let them freeze.

Kingsbury County:—Twenty one samples of seed were distributed in this county and only two of the experimenters reported. Weather report same as in preceding county. Mr. Gleason planted on black loam manured in 1889 with stable manure. Mr. Masters reports dry weather in his section and thinks there would have been better results if more rain had fallen.

JERAULD COUNTY:—But three samples of seed were asked for from Jerauld and one sample of beets was sent in for analysis. Mrs. Atwood planted on black sandy loam and reports that the beets were still growing when harvested.

SANRORN COUNTY:—One sample of beets from two packages of seeds is the report for this county. Mr. Trinen planted on black sandy loam. His beets were too far apart.

MINER COUNTY:—Seven packages of seed and three samples of beets for this county is this year's record. The weather reports differ but little from the average for this section. Hard frosts in October are noticed. Mr. Bohlman plantəd on old land, black loam, and transplanted to fill out vacancies where seed did not germinate. Mr. Holmes used sandy loam with much sand. Mr. Ogden planted on sandy loam and although water stoon on the plat until in June a fine stand was secured.

AURORA COUNTY:—Five samples of beets were returned from this county. The weather report is about the same as for the other counties. A heavy rain is reported on the 12 of October.

Mr. Swatman planted on black loam. Mr. Townsend planted two varieties on black loam. Owing to the wet spring the beets were sown late. A good opportunity is here seen to judge of the comparative merits of the two strains of beets. The two analyses nearly duplicate each other with a slight advantage for the Kleinwanzlebener type. Mr. Oppel planted on sandy loam but his ground got hard and the beets did not thrive. Mr. Burnham used black loam but it was so wet that the planting was late. Cut worms destroyed many of the young plants at first and on the 22 of June hail ruined many more. About half a stand was secured.

HANSON COUNTY:—Four packages of seed were sent to this county but none of them have been heard from.

DAVISON COUNTY:—Of the four applicants who received seed in this county Mr. Angell is the only one who returned beets for analysis. He planted on black sandy loam, but the seed was slow germinating, taking in some cases till after the third hoeing before they all came through. He firmed the ground on the seed after drilling it in, by laying a board on the row and then stamping on the board.

The following table completes the reports from this section:

Station No.	Variety.	Grower.	Planted.	Harvested.	Rows—inches.	Beets in Row —inches.	Tons per Acre.	Number Beets Analyzed.	Av. Weight — grams.	Per c't. Sugar in Beets.	Per c't. Sugar in Juice.	Degrees Brix.	Purity Coefficient.	Per cent. Ash in Juice.	Per cent. Marc in Beets.	Pounds Sugar per Acre.
		BROWN COUNTY—														
395	V	N. Fulker	June 5	O't 14	18	....	....	6	325	15.20	16.05	21.40	75.00	1.52	5.28	.....
403	V	S. W. Narregang	May 1	O't 15	22	3	39	8	250	18.30	19.28	21.00	91.81	.91	5.08	14274
410	K	O. P. Hansen	May 13	O't 21	....	....	....	4	829	12.50	13.03	16.10	90.00	1.17	4.17	.....
412	K	Chas V. Webber	May 9	Sep 22	22	8	24½	3	812	11.80	12.35	16.50	74.85	1.50	4.43	5782
417	V	O. C. Matteson	May 22	O't 25	20	6	16½	5	789	13.00	13.57	16.50	82.24	1.19	4.30	4290
424	V	Geo. Vetter	May 11	O't 27	22	5	28	5	474	13.20	13.87	18.00	77.06	1.19	4.86	7392
433	V	H. J. Miller	May 25	O't 25	22	5	25	5	477	12.50	13.08	16.60	78.79	1.19	4.41	6250
447	K	H. C. Coburn	"	"	22	9	16	5	452	12.50	13.18	17.70	74.46	1.19	5.16	4000
462	V	C. J. Edson	May 12	O't 31	22	5	19	5	454	14.20	14.83	19.00	78.05	1.58	4.24	5396
480	V	Wm. Crockard	May 6	Nov 2	27	....	....	5	478	13.00	13.58	16.10	84.35	1.13	4.29	.....
489	K	Robt. Moody	Apr 23	O't 26	22	5	20¼	5	552	9.90	10.29	15.50	66.39	2.21	3.75	4009
522	V	J. W. Svarstad	May 6	O't 22	22	6	23	5	446	16.35	17.20	20.40	84.30	.99	4.90	7521
		MCPHERSON COUNTY—														
488	V	Geo. B. Reid	May 20	Nov 1	22	9	11	5	326	16.70	17.65	19.60	90.05	1.05	5.40	1837
		EDMUNDS COUNTY—														
396	K	J. W. Brown	May 6	O't 20	22	6	46⅓	5	589	14.30	14.98	18.40	81.41	1.22	4.55	13251
400	V	W. H. H. Dickinson	May 28	"	22	6	10	5	514	14.20	14.84	17.80	83.37	.91	4.34	2840
402	K	John Bergman	May 18	O't 22	24	8	20¾	5	680	14.80	15.52	19.20	80.83	1.22	4.66	6142
474	V	S. L. Bakkegard	May 15	O't 24	20	....	15½	5	486	18.70	19.65	22.10	88.91	1.39	4.83	5797
477	K	H. Hilton	May 5	Nov 1	22	5	33	5	536	15.50	16.28	18.80	86.69	.94	4.79	10230
		FAULK COUNTY—														
441	V	S. S. Wentworth	May 16	O't 27	48	7	31.3	2	683	15.10	15.80	20.40	77.45	1.24	4.40	9452
442	K	do	"	O't 27	48	7	32.2	2	749	13.15	13.71	18.20	75.33	1.41	4.13	8468
486	V	A. M. Thompson	May 14	O't 24	22	5	26	6	412	17.10	17.96	20.10	89.35	1.01	4.80	8892

		SPINK COUNTY—														
393	K	G. W. Else	May 5	O't 20	18	6	23.7	5	575	15.50	16.20	16.40	98.78	1.00	4.30	7365
405	V	W. F. Sander	Apr 28	" 24	22	5	15	5	474	15.30	16.05	19.20	83.59	1.16	4.69	4590
418	K	E. C. Perkins	May 30	" 25	22	11	14	5	596	12.00	12.40	15.70	79.55	1.31	3.94	3360
446	K	W. L. Thomas	Apr 28	" 26	22	6	15	5	327	11.65	12.11	15.80	76.65	1.10	3.79	3495
454	K	R. Brunn	May 4	" 26	36	8	19.8	2	1048	11.25	11.69	18.00	64.94	.91	3.77	4455
464	V	R. Bingham	" 20	" 28	45	....	....	....	710	10.80	11.27	14.50	77.72	1.22	3.80	.....
466	V	F. J. Carrier	" 3	" 25	22	4	20	5	446	15.80	16.54	20.00	82.70	1.23	4.49	6320
499	K	H. Wilson	Jun 15	" 20	24	5	10.5	5	316	15.10	16.09	18.80	85.58	1.30	5.15	3171
500	V	"	" 24	" 21	24	....	....	3	310	17.00	17.79	21.20	84.86	.98	5.49	.....
		CLARK COUNTY—														
392	V	S. Westover	May 8	O't 22	22	12	39½	3	953	12.30	12.85	16.00	80.31	.90	4.36	9717
425	V	N. T. Waterman	" 26	" 25	30	6	....	5	538	13.00	13.62	17.10	79.65	1.09	4.56	.....
429	V	P. B. Peterson	" 6	" 21	22	4	27	5	560	14.00	14.69	17.70	83.00	.86	4.71	7560
460	V	Mrs. E. C. Schulz	" 11	" 28	22	4	22½	5	411	10.20	10.72	19.00	56.42	.94	4.82	4590
483	V	E. A. Howey	" 6	" 25	22	10	31½	4	868	14.80	15.42	18.40	83.80	1.19	4.04	9324
503	K	R. M. Weston	" 6	" 29	30	6	29	3	529	11.30	11.80	16.00	74.00	1.68	4.33	6554
		HAND COUNTY—														
421	K	Oliver Pash	May 15	O'c 25	18	5	28.8	4	518	15.90	16.68	20.20	82.57	1.10	4.69	9158
538	K	James Jones	" 12	" 22	22	6	40	2	1040	13.87	14.60	18.80	77.66	...	....	11096
		BEADLE COUNTY—														
423	V	Chas. R. Fuller	May 6	O't 26	22	10	16½	4	454	14.60	15.35	19.80	77.53	1.19	4.90	4818
493	V	Simon Keator	" 20	" 22	22	5	15	5	496	8.90	9.21	14.50	63.52	1.93	3.39	2670
523	K	C. A. Campbell	" 6	" 25	22	4	11½	5	372	15.10	15.90	22.00	72.30	1.40	5.18	3473
524	V	C. S. Sprague	" 11	" 24	22	11	11¼	5	352	17.25	18.25	21.40	85.30	.82	5.47	3381
		KINGSBURY COUNTY—														
439	V	W. L. Gleason	May 10	O't 24	22	6	22	3	1092	11.10	11.57	15.70	73.70	1.27	4.06	4884
505	K	J. F. B. Masters	June 5	" 28	22	6	14	5	283	12.80	13.30	15.80	84.00	1.13	4.80	3584
		JERAULD COUNTY—														
451	K	Mrs. S. E. Atwood	May 6	O't 21	22	5	21	4	499	11.15	11.60	17.70	65.54	1.55	3.88	4683
		SANBORN COUNTY—														
506	K	Peter Trinen	May 15	O't 22	46	8	27	3	752	12.40	13.00	16.00	81.00	1.31	4.27	6696
		MINER COUNTY—														
427	K	M. Bohlman	May 12	O't 27	22	6	24	5	428	14.20	14.85	19.00	78.16	1.30	4.40	6916
444	K	H. T. Holmes	" 1	" 25	22	6	20	5	497	11.65	12.19	16.00	76.19	1.25	4.44	4660
487	K	A. B. Ogden	" 2	" 31	22	5	34½	5	586	12.70	13.20	17.50	75.43	1.36	3.94	8763

Station No.	Variety.	Grower.	Planted.	Harvested.	Rows—inches.	Beets in Row—inches.	Tons per Acre.	Number Beets Analyzed.	Av. Weight—grams.	Per c't Sugar in Beets.	Per c't. Sugar in Juice.	Degrees Brix.	Purity Coefficient	Per cent. Ash in Juice.	Per cent. Marc in Beets.	Pounds Sugar per Acre.
		AURORA COUNTY—														
422	V	M. G. Swatman..........	May 1	O't 26	22	6	14	5	441	15.70	16.49	20.00	82.45	.80	4.81	4396
472	V	D. G. Townsend.........	June 8	" 24	30	....	20	4	834	13.60	14.23	18.20	78.19	1.56	4.45	5440
473	K	"	" 8	" 24	30	....	21	4	762	13.60	14.26	18.20	78.35	1.78	4.65	5712
491	K	J. P. Oppel..............	May 10	" 25	36	10	12½	5	464	11.80	12.33	17.80	69.27	1.48	4.27	2950
507	K	V. E. Burnham..........	" 23	Nov 5	22	8	15	5	557	14.20	14.90	17.20	86.00	1.02	4.53	4260
		DAVISON COUNTY—														
518	K	F. B. Angell.............	May 7	Nov 1	22	6	29	5	558	14.60	15.30	17.80	86.00	1.52	4.31	8468

THE MISSOURI RIVER REGION.

CAMPELL COUNTY:—Two packages of seed were sent to this county and two packages of beets were returned. The weather report is as follows: May, rainy; June, rainy and hot; July, first part rainy and cool; second warmer; August and September dry and hot; October dry nnd cold.

Mr. Larson used black sandy loam and secured good results. He asks if there is any way that molasses may be made out of the beets. In a small way some parties in South Dakota have already made molasses from the juice of the Sugar Beet. The beets are grated and the juice expressed in a manner similar to the process used in making cider from apples. The juice is simply boiled and skimmed. No doubt an improvement might be made by using lime water to clarify the juice. This might also remove some of the taste peculiar to sugar beets. Mr. Gjefle did not complete his report.

WALWORTH COUNTY:—Two packages of seed and two samples of beets is the report for this county. The weather report is similar to that of the preceding county. Mr. Payne employed a reddish black bunch grass soil. Land was fertilized two years ago. Mr. Welch planted on sandy loam mixed with clay and used no fertilizer this year.

POTTER COUNTY:—Fourteen packages of seed were sent to this county and seven samples of beets were returned. The weather report is similar to the preceding. Frosts are reported in October. It might be well to observe here that sugar beets will stand a rather severe frost without suffering any material damage after they are mature and while they are still in the ground.

Mr. Huyck used a deep black loam that has been in garden since 1885. Hen manure has been used sparingly. Some of the beets washed out but the places were filled in by transplanting. Mr. Walter used a dark sandy loam manured last season with well rotted stable manure. Hail injured the leaves severely. Mr. Gorman used a gravelly and sandy loam never fertilized. Mr. Scanlon used bunch grass soil and no fertilizer. Mr. Naylor sowed on black prairie loam and used no fertilizer.

Had raised beets on same ground for two years. His beets gave the highest percentage of sugar of any samples coming to this laboratory this year. Mr. Cattron used dark loam, no fertilizer and secured a good stand. Mr. Mancher used a variable soil but it was poorly prepared and plowed very shallow.

SULLY COUNTY:—Five packages of seed and five samples of beets is the report from this county. None of the observers report frosts in October.

Mr. Schreiber planted on black loam and secured about half a stand owing to the formation of a crust on the ground soon after the beets were sown. Mr. Schultz planted on black loam and his plants were injured during the dry weather by a long grayish beetle. Mr. Spitz gives a similar report. Mr. Fagner reports an extra fine stand and finds the beets good both for stock and for table use. Mr. Porter planted on black loam and found the beets easier to cultivate than he expected.

HYDE COUNTY:—Three samples of seed were sent to this county and one sack of beets was returned. Mr. Lawson planted on a clay loam and gives a report of the weather not varying much from the preceding.

HUGHES COUNTY:—Seventeen samples of seede and five sacks of beets returned. The reports for the weather are as usual but October is spokon of as a warm month.

Mr. Chandler sowed on light sandy soil and reported a number of beets in outside rows that weighed over eight pounds. Mr. Fuller planted on black loam near a draw and a heavy rain washed out many of the beets. Mr. Chandler used a deep sandy loam and thinks the late spring a great disadvantage. Mr. Millett sowed on sandy loam but his beets were not properly tended. The ground caked and the beets were injured when the weeds were pulled out. Mr. Purinton planted on sandy timber land but his beets were too far apart. He suggests that the Experiment Station should furnish the seed to farmers at cost as they are fine for stock. Farmers can buy as cheaply and of the same parties as the Experiment Station can.

BUFFALO COUNTY:—Mrs. Johnson sowed on sandy loam. The ground was sloping so that much of the seed washed out.

The weather report is substantially as the preceding. Three samples of seed were sent to this county.

BRULE COUNTY:—Four packages of beets were returned for the seven samples of seed distributed to this county. The weather resembled the preceding.

Mr. Wolbert used black loam and secured fine results. Mr. Crisford planted on black loam and simply sent five beets about right size. Mr. Rigney sowed on a dark sandy loam. His beets were injured by grass hoppers. Mr. Vanloan used gravelly clay. During July and August a long, slim bug ate the tops all off the beets.

CHARLES MIX COUNTY:—One sample of beets came from this county while five samples of beet seed were sent out. Weather report as preceding.

Mr Miner planted on black clay loam. His beets were large and he reports the enormous yield of 95 tons per acre. This is a most extraordinary yield and the analysis shows surprising results.

BON HOMME COUNTY:—Six samples of beets were received from seventeen packages of seed. Frost is reported in October.

Mr. Mullinger used bottom land rich with mold. His beets grew large and were poor in sugar. Mr. Kirk planted on sandy loam fertilized last year with barn yard manure. Mr. Bullis used a light black soil. His beets were too far apart and were poor in sugar. Mr. Hook planted on sandy soil and obtained a large yield although the per cent. of sugar was rather low. Mr. Heitgen planted on sandy soil and fertilized with barn yard manure. Mr. Schmidt planted on loamy soil but the ground became very hard.

YANKTON COUNTY:—Mr. Nelson sent in beets raised from seed sent by Secretary Rusk, Dippes Kleinswanzleben. He used a black loamy soil and his results are good. He reports the weather about the same as before.

The following table completes the report for this region:

Station No.	Variety.	Grower.	Planted.	Harvested.	Rows—inches.	Beets in Row —inches.	Tons per Acre.	Number Beets Analyzed.	Av. Weight — grams.	Per c't. Sugar in Beets.	Per c't. Sugar in Juice.	Degrees Brix.	Purity Coefficient.	Per cent. Ash in Juice.	Per cent Marc in Beets.	Pounds Sugar per Acre.
		CAMPBELL COTNTY—														
519	V	Jno. Larson...............	May 5	Nov 2	22	7	16	5	448	17.00	17.80	20.00	88.00	1.23	4.69	5540
530	V	S. O. Gjefle...............	" 23	O't 28	22	8	....	5	450	14.25	14.98	18.10	83.00	.86	4.85	.....
		WALWORTH COUNTY—														
411	K	W. H. Payne.............	May 3	O't 22	22	5	19¾	5	445	16.50	17.22	19.20	89.68	1.28	4.20	6517
542		F. W. F. Welch..........	" 15	Nov 4	20	5	30	5	520	14.73	15.50	18.80	82.40	....	....	8838
		POTTER COUNTY—														
404	K	M. Huyck................	May 2	O't 24	22	3	24½	5	560	13.60	14.24	17,40	81.84	1.13	4.50	6664
414	K	John Walter.............	" 16	" 22	22	7	13½	5	544	16 40	17.17	21.20	81.00	1.50	4.55	4428
453	V	R. T. Gorman............	" 11	" 28	22	6	17	5	374	16.10	17.00	21.20	80.19	1.33	5.32	5474
490	V	W. E. Scanlon	" 11	" 22	22	6	70½	4	950	13.20	13.81	16.80	82.20	1.47	4.41	18612
515	V	Jas. Naylor, Jr...........	" 19	" 31	22	6	20	5	377	20.40	21.60	23.60	91.53	.85	5.63	8160
529	K	C. F. Cattron............	" 21	Nov 6	22	6	17¾	5	584	15.40	16.10	18.60	86.50	1.17	4.40	5467
541	K	Edward Mancher........	" 27	O't 22	48	....	....	6	383	14.63	15.40	20.50	75-10	....	....	.....
		SULLY COUNTY—														
531	K	Thos. Schriber..........	May 14	Nov 7	22	9	15	5	452	14.60	15.26	17.60	86.70	.72	4.32	4380
439	K	E. Schulz................	" 7	O't 24	22	8	10	4	561	12.50	13.11	17.30	75.78	1.13	4.65	2500
482	K	E. Spits..................	Apr 4	" 31	22	7	10	5	377	15.20	15.94	20.80	76.63	1.91	4.64	3040
509	K	F. E. Fragner............	May 11	" 22	22	6	15	5	634	18.10	19.00	21.30	89.20	1.05	4.53	5430
521	V	C. B. Porter..............	" 14	" 24	22	7	19¾	5	556	14,90	15.70	17.80	88.00	1.16	5.00	5885
		HYDE COUNTY—														
501	V	W. O. Lawson............	May 11	O't 31	22	6	4	6	214	15.40	16.29	20.90	77.94	1.19	5.45	1232
		HUGHES COUNTY—														
419	K	A. M. Chandler..........	Apr 30	O't 24	22	6	33	5	443	16.10	16.80	18.60	90.32	1.17	4.19	10626
428	V	E, B. Fuller..............	May 16	" 25	22	4	33¾	4	605	16.10	16.92	19.20	88.13	.84	4.85	10867
438	V	L. A. Chandler	" 7	" 24	22	4	20	5	425	13.90	14.69	18.00	81.61	.95	5.40	5560

450	K	G. J. Millett.	" 16	" 27	22	13	35½	4	623	10.20	10.64	16.60	64.10	1.84	4.22	7242
458	K	R. E. Purinton	Apr 30	" 27	44	12	18	3	1084	11.15	11.64	16.40	70.98	1.65	4.23	2007
		BUFFALO COUNTY—														
536	K	Mrs. M. C. Johnstone	May 26	O't 29	22	6	7½	5	400	13.68	14.40	20.20	71.30	....	....	2052
537	V	do	"	"	22	6	6½	5	340	16.91	17.80	23.00	73.00	....	....	2198
		BRULE COUNTY—														
426	V	Adam Wolbert	May 23	O't 20	22	8	24	5	516	17.50	18.43	20.70	89.03	1.13	5.05	8400
468	K	Jno. Cresford	" 5	" 24	22	5	16	5	438	14.30	15.07	18.90	79.73	1.13	5.12	4576
471	K	P. Rigney	" 7	" 20	....	....	....	3	800	14.60	15.27	19.20	79.53	1.64	4.40	.....
476	V	J. A. Van Loan	" 2	" 28	22	5	32½	5	422	14.60	15.35	19.20	79.95	1.59	4.92	9490
		CHARLES MIX COUNTY—														
432	V	H. W. Miner	May 25	O't 24	22	6	95	3	923	13.40	14.00	16.90	82.83	1.35	4.28	25460
		BON HOMME COUNTY—														
457	V	R. Mullinger	......	O't 24	22	6	40	3	905	9.55	10.01	15.00	66.73	1.69	4.69	3820
467	K	Jas. Kirk	Apr 30	" 28	22	9	34	5	594	17.30	18.12	21.00	86.29	1.09	4.51	11764
495	K	N. A. Bullis	" 23	" 31	44	5	....	5	468	10.70	11.20	14.80	75.67	.98	4.48	.....
497	V	Jno. Hook	" 30	" 17	22	4	56	4	525	11.70	12.27	15.80	77.65	1.13	4.63	11700
498	K	M. Heitgen	May 28	" 21	22	8	19	3	840	10.10	10.51	15.60	67.37	1.26	3.89	3838
514	V	J. B. Schmidt	Apr 30	Nov 3	22	8	16	5	510	16.40	17.20	19.40	88.60	.93	4.62	5248
		YANKTON COTNTY—														
435	V	T. Nelson	May 28	O't 26	24	8	18	4	500	15.40	16.16	20.00	80.80	1.23	4.73	5544
436	K	"	"	"	24	6	24	4	565	14.20	14.79	20.30	72.85	1.61	3.97	6816

THE BLACK HILLS REGION.

Forty six applications for seed were received from this region and fifteen samples of beets have been returned. The analyses of the samples sent make a very creditable showing. Not one has fallen below the standard required for sugar making and a good percentage shows a high standard. The weather report is, May wet and cold; June wet and cool; July and August hot and dry; September wet and moderately warm; October first part dry and warm, last part wet and cold.

CUSTER COUNTY:—Mr. Sanborn planted on sandy land and used no fertilizer. Mr. Stoltz planted on gumbo and let the beets take care of themselves. Mr. McVey sent no report with his beets. Mr. Boland planted on a red gypsum soil and some of the seed failed to germinate. He filled in the breaks with sweet corn and cultivated the beets with the corn.

BUTTE COUNTY:—Mr. Vallery planted on gumbo alkali soil which becams so hard it deformed the beets.

FALL RIVER COUNTY:—Mr. Wight planted on sandy loam with no fertilizer and simply hoed twice. Mr. McDowell planted on made land composed of sand and clay. Mr. Ball planted on low sandy soil and kept clean from weeds.

LAWRENCE COUNTY:—Mr. Breslin planted on strong clayey soil mixed with sand. His crop was injured some by a heavy rain and hail storm in June. Mr. McLaughlin used gypsum soil.

MEAD COUNTY:—Mr. Heinrichs used a high sandy soil mixed with lime stone and he used no manure.

PENNINGTON COUNTY:—Mr. Nelson planted on light black loam but the deep plowing threw up too much raw subsoil. The plowing should have been done in the fall. He has saved beets to plant for seed. Mr. Stucker used sandy loam. Mr. Thompson planted on sandy loam situated in the foot hills, on Mr. Little's ranch. Had a good stand. Mr. Jornston planted on black loam with very little sand. The following table completes the report for this region:

Station No.	Variety.	Grower.	Planted.	Harvested.	Rows—inches.	Beets in Row —inches.	Tons per Acre.	Number Beets Analyzed.	Av. Weight—grams.	Per c't Sugar in Beets.	Per c't. Sugar in Juice.	Degrees Brix.	Purity Coefficient	Per cent. Ash in Juice.	Per cent. Marc in Beets.	Pounds Sugar per Acre.
		CUSTER COUNTY—														
407	V	G. C. Boland	May 12	O't 20	22	....	....	4	650	14.80	15.50	17,50	88.57	.96	4.49	.....
409	K	G. O. Sanderson	" 5	" 21	22	5	28½	5	516	13.30	13.91	16.20	85.86	.98	4.44	7581
508	V	F. Stoltz	June 1	Nov 3	36	12	....	4	668	12.80	13-40	16.00	84.00	1.16	4.50	.....
534	V	E. D. McVey	......	......	....	....	....	4	792	13.77	14.50	19.00	76.32	....	....	.....
		BUTTE COUNTY—														
416	K	P. P. Vallery	May 21	O't 22	16	8	42.7	4	769	12.10	12.64	16.80	75.24	1.37	4.28	10334
		FALL RIVER COUNTY—														
469	K	Stephen Wight	Apr 31	O't 28	22	10	16	5	511	15.30	16.14	18.40	87.72	1.04	5.23	4896
481	K	F. C. McDowell	" 28	Nov 1	....	....	18.2	5	376	16.50	17.22	21.90	78'63	1.49	4.22	6013
532	K	J. A. Ball	" 30	" 2	22	4	22	5	498	13.20	13.90	17.30	80.40	1.31	4.79	2904
		LAWRENCE COUNTY—														
475		Jno. Breslin	May 6	O't 28	24	....	18	5	722	15.20	16.03	19.20	83,49	1.40	5.19	5572
510	K	Jno. McLaughlin	" 10	" 29	36	6	9⅓	5	415	15-50	16.30	20.00	81.50	1.29	4.95	2892
		MEAD COUNTY—														
511	V	R. Heinrichs	May 16	Nov 2	22	6	12	5	402	17.10	18.04	20.60	87.60	1.43	5.23	4104
		PENNINGTON COUNTY—														
502	V	J. A. Nelson	May 7	O't 29	22	10	10	5	425	17.00	17.99	21.60	83.30	.99	5.48	3400
513	V	F. Stucker	" 18	" 28	22	4	35	3	847	15.70	16.50	18.80	87.80	1.05	5.11	11990
516	K	T. Thompson	" 13	" 21	22	8	....	5	486	14.30	14.99	18.00	83.30	.86	4.61	.....
525	V	W. H. Johnson	" 30	" 31	22	8	10½	5	298	14.10	14.99	20.00	74.95	1.04	5.91	2961

SUMMARY OF RESULTS FROM THE WHOLE STATE.

160 analyses all told were made this season. One sample came from outside of the state and the report is not included. One sample was spoiled when it reached the Station Laboratory and the analysis is thrown out as wortnless.

Arranged according to percentages the work makes the following exhibit:

Under 12.00 per cent sugar in the beet,	27	samples.
Between 12 and 13 per cent sugar in the beet,	13	"
" 13 and 14 " " " "	26	"
" 14 and 15 " " " "	34	"
" 15 and 16 " " " "	28	"
" 16 and 17 " " " "	13	"
" 17 and 18 " " " "	10	"
" 18 and 19 " " " "	6	"
Over 20 per cent sugar in the beets,	1	"

Considering the number of experimenters, and considering the confessedly bad care some of these experimenters gave the trial plats, and considering the bad season it is evident that nearly every portion of the state is capable of raising beets well adapted to sugar manufacture. An inspection of the yield in tons of beets per acre will show a profitable yield. It is true that the experiments were made with excellent seed, but such seed is easily obtainable by importation or it can be grown at home.

In consideration of the trial now extending over four years and of the results obtained it is safe to say that further experimentation in this line is unnecessary. The fact may be accepted that most portions of the state can raise sugar beets of a high grade for sugar manufacture.

SOUTH DAKOTA

AGRICULTURAL COLLEGE

AND

EXPERIMENT STATION

BROOKINGS, S. D.

BULLETIN NO. 35.

MAY 1893.

DEPARTMENTS OF
Horticulture and Forestry, Botany and Entomology.

FUNGOUS DISEASES. INSECT PESTS. FUNGICIDES AND INSECTICIDES.

DUTCHER, BREED & STORGAARD, BROOKINGS.

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L. C. CORBETT,	Horticulturist
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C. G. HOPKINS,	Assistant Chemist
H. B. MATHEWS,	Assistant Meteorologist
L. E. WINSLOW,	Stenographer
A. W. WILLIAMS,	Foreman of the Farm

The Bulletins of this Station will be sent free to all citizens of the State who will apply for them.

All letters and other mail matter for the Station should be addressed to the Experiment Station.

COMMON FUNGOUS AND INSECT FOES OF FARM AND GARDEN.

THOMAS A. WILLIAMS.

I. FUNGOUS DISEASES.

APPLE SCAB.

(*Fusicladium dendriticum.*)

This attacks both leaves and fruits and often also the young twigs. Though the fungus grows on both sides of the leaf it is most conspicuous on the upper surface. It appears as a network of fine greenish brown or blackish filaments and causes the leaves to become discolored, curl up and fall off. On the fruit it produces irregular, dark greenish brown, velvety blotches and while not causing any great amount of decay, hinders growth and deforms the fruit. In very bad cases young fruit shrinks up and falls off.

TREATMENT.—If trees were attacked by "scab" the preceding year, all leaves, rubbish, decayed fruit and the like that is on the ground about them should be raked up and burned. About the time the blossoms fall or as soon thereafter as practicable spray with either of the fungicides *XII, XIII or XIV. The most satisfactory results will be obtained if the operation is repeated at intervals of from two to three weeks (depending on the weather) until the fruit is half grown.

APPLE TWIG BLIGHT.

(*Micrococcus amylovorus.*)

This disease often called "sun scald," "fire blight," etc., is due to one of the bacteria. This little organism attacks the young rapidly growing twigs, and no doubt obtains a start wherever the bark of the tree has been broken.

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*Roman numerals refer to formulae for preparing fungicides and insecticides.

Treatment.—As the injury is too deep seated, spraying will do no good except indirectly. Carefully pruning and burning affected parts, if followed up, will usually keep an orchard comparatively free from this disease. The pruning knife should be handled with the utmost caution as the disease may be carried by it from one tree to another.

SPOT DISEASE OF PLUM AND CHERRY.

(*Cylindrosporium padi.*)

This disease is also known as the "shot hole disease" from the peculiar effect it has upon the leaves particularly those of the plum. It appears first as reddish or discolored spots on the leaves. These spots are at first usually less than one-sixteenth of an inch in diameter, but increase in size, often running together forming large irregular areas. Sometimes the diseased part falls out giving the leaf the appearance of having been perforated by several to many large shot, hence the name —shot hole disease. This is more liable to occur in plums and peaches. The diseased leaves after a time turn yellowish and fall prematurely. The common black cherry and some varieties of plums have suffered severely from this disease, here, of late years. The younger shoots and plants suffer most.

Treatment.—In this region spraying should begin not later than June 1 and should be continued through the summer at intervals of about three weeks if the disease is very damaging. Use either XII or XIII giving the trees a thorough spraying. The bordeaux mixture is perhaps the better fungicide all things considered.

PLUM AND CHERRY BLIGHT OR MILDEW.

(*Podosphaera tridactyla.*)

This disease attacks the leaves, covering them with a network of fine whitish filaments, and causing them to curl up and fall off; in extreme cases leaving the twigs entirely leafless.

Sand cherries suffer severely from this disease.

Treatment.—As this fungus grows almost entirely on the surface of the leaves it is comparatively easy to deal with. Beginning usually in June the trees should be sprayed thoroughly with either XII or XIII. This should be continued throughout the season as often as seems necessary. Nos. XII, XIII and a sulphur mixture sold under the name of "Par Oidium" were tried last season on plums and sand cherries on the Station grounds. The Par Oidium was a failure while both the other treatments were successful. There seems to be but little choice between them so far as efficiency is concerned. Some prefer No. XII.

BLACK KNOT OF PLUM.

(*Plowrightia morbosa.*)

The wild plums and most cultivated varieties, particularly those derived from native forms, suffer considerable damage from this disease. It produces great black, unsightly wart-like growths on the stems and branches, disfiguring them and finally either killing the tree outright or rendering it useless as a bearer of fruit. Cherries are often affected also.

TREATMENT.—The fungus is too deep-seated to be reached by any ordinary fungicide applied to the surface. When but few knots appear they may be cut away and burned and the tree thoroughly washed with No. XIII. Or better the knots may be saturated with linseed oil or painted with a mixture of red oxide of iron in linseed oil. If badly affected, the tree should be cut and burned.

PLUM POCKETS.

(*Exoascus pruni.*)

This fungus attacks the fruit, leaves, and in some cases the young twigs. Last year it was very destructive and promises to be as bad this season. On plums the fruit suffers most while on sand cherries fruit, twigs and leaves are affected. The diseased parts swell up and become more or less distorted; the fruit being often three times its normal size, but hollow and puffed up, hence the name—plum pockets.

TREATMENT.—As the parasite goes through with most of its development within the tissues of the host, spraying alone will not suffice. All the diseased parts should be cut away and burned. The plants may then be sprayed with XII or XIII to keep the fungus from getting a new start.

SPOT DISEASES OF CURRANT.

(*Septoria ribis and Cercospora angulata.*)

These diseases appear usually some time in June. Small brownish spots are formed on the leaves. These are at first roundish or somewhat angular, but often become confluent and are of a grayish color when fully matured. The leaves usually turn yellowish and soon fall off. Both cultivated and wild currants suffer from these fungi. Gooseberries are also attacked but usually less severely.

Treatment.—Beginning the first week in June spray with XII or XIII. In very bad years, four or five applications should be made during the season. *Both sides* of the *leaves* should be thoroughly wet with the spray.

STRAWBERRY LEAF-BLIGHT.

(*Sphaerella fragariae.*)

This is also known as "strawberry rust," "sun scald," "sunburn," "spot disease," etc. It appears first as brownish or more often red or red-purple, circular spots on the leaf. Very often there are several to many of these spots on a single leaf. As the spots grow older they become white in the center, the border remaining red, purplish or brownish. They are usually $\frac{1}{8}$ to $\frac{1}{4}$ of an inch in diameter at maturity.

Treatment.—A thorough application of No. XII just before the disease makes its appearance (usually in June) will be sufficient in most cases. In moist seasons cutting the leaves close to the ground by running a mowing machine over the bed, and burning as soon as dry is recommended as a preventative for the next season. In dry weather this method should be used with caution, if used at all.

POTATO SCAB.

(*Oospora scabies.*)

This disease is too well known to need much description. The scabby areas on the surface of the potato are familiar to all. The disease is due to a very minute fungus. The damage has been considerable in some parts of the state the last few years. Beets are subject to the same disease.

TREATMENT.—In the first place "scabby" seed should not be planted, and soil that has previously produced diseased potatoes or beets should not be planted to either until several seasons have passed. If diseased seed must be planted or if potatoes are to be kept free from scab, all seed should be treated with XIII or better with XV. The seed should be soaked about one and a half hours in either of the fungicides before planting.

II. INSECT PESTS.

CODLIN MOTH.

(*Carpocapsa pomonella.*)

This insect infests the fruit of the apple. The mature insect is a small, ashy-gray and brown moth, about three-fourths of an inch from tip to tip of the expanded wings. The eggs are laid singly in the blossom ends of the young apples. After about a week the larva hatches and eats its way into the core. It makes its presence known by pushing its castings out of the hole by which it entered or by making a new one at the side of the apple. The insect passes the winter in the pupal state, often in apple barrels in the cellar. It is without doubt the most serious insect pest of the apple.

TREATMENT.—Destroy all wormy fruit as soon as it falls to the ground. A thorough application of either IX or X just after the young fruit has "set" but before it has become heavy enough to droop, or the calyx end to turn down, will reduce the wormy apples to a very small per cent. Two thorough applications will suffice; one at the falling of the blossoms and the other ten days or two weeks later.

GOOSEBERRY AND CURRANT SPAN-WORM.

(*Eufitchia ribearia.*)

Here in the Dakotas, this insect is probably the worst pest that the grower of these small fruits has to contend with. The mature insect is a moth pale yellowish in color with several dusky spots arranged in one or two irregular bands extending across the wings. The caterpillar, when full grown, measures an inch or more in length. It is whitish with yellow, black, pink and purple markings. It usually appears about the last of May or the first of June.

TREATMENT.—As the fruit is often so nearly ready to pick when the pest is hardest at work, it is not advisable to use the arsenical mixtures. No. XI used either as the dry powder or in water will prove an effective remedy if used very strong.

CABBAGE WORMS.

(*Pieris rapae*, *P. protodice and Plusia brassicae.*)

Several different caterpillars are injurious to cabbage; the one of most importance with us being the "Imported Cabbage Worm." The adult insect is a common white butterfly, with a few black spots on the wings. The larvae are about one and a half inches long, greenish with yellow and black markings.

TREATMENT.—As the cabbage is a food plant the arsenical mixtures cannot be used. Nos. IV or XI either dry or in water have been used with success. Where the caterpillars can be reached by it hot water is an effective remedy. It should be at 130° to 140° Fahr. when it touches the insect. If put into the sprinkler when *boiling* and applied immediately, it will be at about the proper temperature.

POTATO BEETLES.

(*Doryphora 10-lineata and Epicauta spp.*)

The first of these insects is the "Colorado potato beetle," and is readily recognized by its yellowish color and the ten longitudinal black stripes on its wings. The eggs are orange-yellow and are deposited in clusters on the under side of the leaves. The larvae are reddish with a double row of black spots along the back when fully developed. The other beetles feeding on the potato are the common black "blister beetle" and the "striped blister beetle." The former is more common here. They can be distinguished from the "Colorado potato beetle" by their more slender, cylindrical bodies and longer antennae; the commoner form is also black in color.

TREATMENT.—All the potato beetles can be held in subjection by the use of IX or X. Application should be made as soon as the insects appear in the spring and should be repeated as often as necessary. As there is more than one brood of the "Colorado potato beetle" more than one application will usually be necessary.

PLANT LICE.

(*Aphididae.*)

These little insects are very injurious to some of our common trees and garden stuffs. They are usually rather small either winged or wingless, and vary greatly in color; being generally green, reddish brown or black. They get their nourishment by sucking up the juices of the plant upon which they live. Many of them cause curling and twisting of leaves and twigs. Some are covered more or less with a waxy or cottony secretion which serves as a protection. Some of our most injurious species are those found on cabbage, apple, plum and cherry, willow and cottonwood, boxelder, elm, ash, etc.

TREATMENT.—As these insects feed by sucking and not by chewing, poisonous mixtures are of no avail but insecticides must be used that kill by contact with the body of the insect. Nos. I, II, VI, VII, and VIII may be used in fighting these pests. For hardy trees and shrubs and most other out of door plants the kerosene emulsions are perhaps most to be preferred. For cabbage lice a strong soap suds is preferable. In conservatories the various soap and tobacco remedies are more often used.

COTTONWOOD AND WILLOW LEAF-BEETLES.

(*Lina scripta and L. lapponica.*)

These insects are without doubt the worst insect enemies of our cottonwoods, willows aud poplars. The striped or spotted beetles and their disgusting larvae are familiar to all who have tried to grow these trees.

TREATMENT.—These insects feed by biting and chewing up the green pulp of the leaves, and so may be successfully checked by the use of poisons. Thorough applications of either IX or X just as the larvae begin their depredations will be successful. As the insects are several brooded the trees should be closely watched and again treated if the larvae reappear.

LARGE WILLOW SAWFLY.

(*Cimbex americana.*)

This is the worst enemy of the willows. The adult insect is a large dark colored bee-like insect usually with more or less prominent white spots along the abdomen, particularly in the case of the female. The larvae are great, cylindrical, yellowish-white worms.

Treatment.—They are easily killed by the use of either IX or X. The spraying should be done just after the larvae are hatched. If there are only a few trees hand picking will suffice.

ASH SAWFLY.

(*Monophadnus bardus.*)

The adult of this insect is a "four winged fly about one third of an inch in length, in color black, with thorax above and in front dull orange or honey red." The larva are yellowish-green about an inch in length.

Treatment.—The same remedies given for the large willow sawfly are applicable to this and in fact to all sawflies, except where the character of the plant prohibits their use.

ASH TREE SPHINX.

(*Daremma undulosa.*)

The adult of this insect is a large moth, gray with whitish and blackish mottlings. The larvae of this moth as well as those of all the sphingids, may be at once recognized by the "horn" borne at the posterior end of the body. The larvae of the ash sphinx is greenish with variously colored markings along the sides.

Treatment.—When trees are small and but few in number hand-picking may be resorted to. Spraying with IX or X as soon as the eggs have hatched and the young larvae have begun work, will keep them in check. This will apply to all the sphingids.

EMPEROR MOTH.

(*Attacus cecropia.*)

This insect is well known through the state as the worst enemy of the box elder. It is not limited to this tree, however, but feeds greedily upon nearly all of our common trees. It is at once recognized by its large size as a moth and caterpillar, and by its conspicuous cocoons which remain on the trees all winter.

TREATMENT.—The cocoons may be picked off the trees during the winter and destroyed. Kerosene may be poured on the cocoons while on the tree as described in bulletin No. 13 from this station. After the larvae have begun their work the trees may be sprayed with IX or X. Here in Dakota the common sapsucker kills and eats many of the pupae during the winter.

AMERICAN SILKWORM MOTH.

(*Telea polyphemus.*)

This insect is very like the preceding, being nearly as large, but differs in being lighter colored and the cocoon being rounded at the end. The larvae is also shorter and more compactly built. Its habits are very similar to those of the cecropia. Here on the station grounds it seems to be partial to the birches, while the cecropia prefers the box elder.

TREATMENT.—The remedies given for cecropia are also applicable to this insect.

PREPARATION AND APPLICATION OF FUNGICIDES AND INSECTICIDES.

LEE C. CORBETT.

In the use of insecticides we must recognize two laws. First that certain mixtures are designed to kill by contact. These are used to destroy the sucking insects, such as plant lice, which are not affected by the poisonous sprays. The second class of insecticides are those containing some poisonous ingredient which, when thrown upon the foliage and tender parts of the infested plants, kills by being eaten by the mischief-makers. Those of this class are useful only for the treatment of plants suffering injury from insects which eat the foliage.

The following list is selected with reference to the value and ease of both preparation and application.

INSECTICIDES.

The following insecticides are those which kill by contact. The essential principle of any mixture of this class must be a volatile oil of considerable penetrating power in order that it shall act upon the body of the insect, or it shall be a heavy substance capable of forming a coating over the body of the insect and thus prevent the power of respiration. In any case the material used, while sufficient to act upon the body of the insect must not be injurious to the delicate tissues of the plant.

I. KEROSENE EMULSION.—Soft soap, 1 quart, or hard soap, $\frac{1}{4}$ pound; 2 quarts hot water; 1 pint of kerosene. Stir until thoroughly mixed; then dilute with water, using one part of the emulsion to three or four of water. The most satisfactory way of making an emulsion is to use a force pump for mixing; pumping the mixture back into the receptacle several times.

Another method is to use hard soap, $\frac{1}{4}$ pound; boiling water, 1 gallon; kerosene, 2 gallons. Churn or pump the ingredients thoroughly for fifteen minutes. Dilute ten times when using.

II. KEROSENE AND MILK EMULSION.—Sour milk, 1 gallon; kerosene oil, 2 gallons; warm to blood heat and mix thoroughly Dilute 10 times with water and use as a dip or spray.

III. LYE WASH.—1 Pound concentrated lye, or potash 1¼ pounds to three gallons water. This may be applied to branches of trees with brush as a remedy for bark lice.

IV. PYRETHRUM (Buhach.)—Used dry by dusting upon or beneath the plants. In Alcohol:—Put one part of pyrethrum (buhach) and four parts alcohol, by weight, in any tight vessel. Shake occasionally, and after eight days filter. Apply with an atomizer. Excellent for green-house pests. For some plants it needs to be diluted a little. Another good way is to dissolve about four ounces of powder in 1 gill of alcohol, and 12 gallons of water.

V. QUASSIA.—The following is for plant-lice. Boil 4 ounces quassia chips 10 minutes in a gallon of water; strain off the chips and stir in as it cools 4 ounces of soft water. Use syringe or brush in applying and ten or fifteen minutes later give the plant a good syringing with clean water.

VI. SOAP AND TOBACCO.—Dissolve 8 pounds of the best soft soap in 12 gallons of rain water, and when cold, add 1 gallon of strong tobacco liquor.

VII. TOBACCO AS COARSE DUST OR "TOBACCO FERTILIZER." Strewn under melons and squash plants.

VIII.—TOBACCO TEA.—Used as a spray for plant lice, is made by steeping stems or leaves in water for a couple of hours.

POISONOUS INSECTICIDES.

Insecticides of this class kill by being taken into the system of insects for which they are used. Arsenic and its compounds form the active agent of most of such insecticides.

IX. PARIS GREEN.—As a spray use 1 pound to 200 gallons of water. Keep well stirred so that the poison shall be held in suspension. If this is neglected the green will settle to the bottom of the vessel, as it is not soluble in water, and the result will be that the spray will contain little poison at first and too much towards the last. In spraying stone fruits use the mixture more dilute. 1 pound of poison to 300 gallons of water.

X. LONDON PURPLE.—This poison should be used same as Paris green. 1 pound to 200 gallons of water. It should never be used upon peach trees, because the foliage is very susceptible to injury from the arsenites.

XI. WHITE HELLEBORE—Used as a spray. 1 ounce of the poison to 3 gallons of water. When applied it is seldom mixed with anything. A little flour, however, makes it more adhesive.

FUNGICIDES.

At the present time the use of fungicides is quite as important as the use of insecticides in the culture of fruits and vegetables.

XII. AMMONICAL CARBONATE OF COPPER—The stock solution is made by adding 5 ounces of carbonate of copper, to 3 pints of ammonia (26°), this may be kept any length of time in a bottle with a glass stopper. For use dilute with 45 gallons of water.

XIII. BORDEAUX MIXTURE.—Dissolve 6 pounds of copper sulphate in a wooden or earthen vessel. In another tub or vessel shake 4 pounds of *fresh* lime; add enough water to reduce it to the consistency of a thick whitewash. Pour this slowly into the vessel containing the copper-sulphate solution, using a coarse gunny sack stretched across the top of the vessel for a strainer. Dilute to 45 gallons before applying to plants of any kind.

XIV. MODIFIED EAU CELESTE.—Dissolve 4 pounds of copper sulphate in 10 gallons of water, and stir in 5 pounds of sal soda; then add 3 pints of strong aqua ammonia; dilute to 45 gallons.

XV. MERCURIC CHLORIDE (corrosive sublimate) made by "dissolving 2 ounces of the chloride in 2 gallons of water and letting it stand several hours, or over night and dilued to 22 gallons." Corrosive sublimate is very poisonous and should be used with caution. In preparing and applying the mixture always use a wooden or earthen vessel.

XVI. Combination of Insecticede and Fungicide.—The only safe combination of this character, is that of Bordeaux mixture with Paris green or London purple. The combination of these mixtures results in no injury to the foliage of the plants treated, and yet each retains its value to the extent of being as good as when used separately. The great value of the combination is in lessening the cost of treatment, for we save the cost of one application. In preparing the mixture use the formula for Bordeaux mixture given under No. XIII and add to it Paris green or London purple at the rate of 1 pound to each 200 gallons of the mixture. While using keep the mixture well stirred.

APPLYING INSECTICIDES AND FUNGICIDES.

To obtain best results from the use of sprays for preventing injury to our trees and fruits from insects and fungi, it is necessary that the spray be fine, evenly distributed and applied with force. A force pump with a capacity sufficient to give 25 or 30 pounds pressure, with brass cylinder and plunger, will be found to be best and most economical. The brass is not readily acted upon by the chemicals used, and although the first cost of a pump of this class is a lttle more than that of a cast-iron pump, in the long run, as usual, the best is the cheapest.

The most convenient receptacle for the spraying solution, and the one most easily obtained and mounted is a common oil barrel. Mount this upon a sled, the runners of which are made from plank 2x6 or 8 in. and a little longer than the barrel. The width of the sled should not greatly exceed that of the bulge of the barrel. The beams should be made of 2x6 in. plank and hollowed out to make a saddle to receive the barrel. To make the barrel fast to the sled pass a band of hoop-iron over either end and fasten it securely to the runners. When completed we shall have a cask laying horizontally upon a plank sled, to which it is securely fastened. Mount the pump upon the rear end of the barrel, with the handle parallel with the long axis of the barrel. At the front end and on the top side of the barrel remove a portion of one or two of the staves between the second and third hoops leaving an opening 6 in. wide through which the liquid may be poured. To prevent loss of the mixture the opening should be covered with a piece of burlap or oil-cloth. Tack one edge to the barrel having the rest loose to admit of its being turned back to allow the full opening to be used in filling the barrel.

The length of hose needed will depend upon the character and height of the plants to be sprayed. In general, however, from eight to ten feet will be ample, if the nozzle used is suited to throw a fine spray a long distance. If the nozzle has to be carried into the tree on a pole in order to do the required work, the length of the hose must be increased correspondingly.

The nozzle is the all-important attachment of the spraying apparatus.

A nozzle that will throw a fine spray a long distance, and one that will not clog by any fine particles of lime or dirt which might get into the spraying mixture, is what is wanted. Such a nozzle will facilitate the work of spraying more than most any other invention. I believe that such an one has recently been placed upon the market.

For spraying large forest, fruit, or street trees the barrel, as before described, instead of being mounted upon runners, may be placed upon a wagon. This will be found to be most convenient where the trees are at some distance from each other, or in long rows far enough apart to admit the team and wagon.

SOUTH DAKOTA

AGRICULTURAL COLLEGE

AND

EXPERIMENT STATION

BROOKINGS, S. D.

BULLETIN NO. 36

JUNE 1893.

Department of Veterinary Science.

SCAB, LUMPY JAW AND ANTHRAX.

DUTCHER, BREED & STORGAARD, BROOKINGS.

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SCAB, LUMPY JAW AND ANTHRAX.

D. A. CORMACK.

During the past month, we have received many inquiries for information regarding the causes and treatment of the above named diseases.

Many of these communications have been answered direct, but, in order to meet all past and future inquiries, regarding these diseases, we have decided to issue the following information for the benefit of those who are asking for the same.

There is certainly no state in the Union, where contageous and infectious diseases have done so little damage, as in South Dakota, and if stockmen and flockmasters throughout the state, would take more interest in the work of stamping out disease when it makes its first appearance, their loss would be still further reduced. It is the duty of every stock owner to assist the state board of health and their several county boards of health, in taking whatever steps may be necessary, or within their reach, for the cure of the afflicted or for the protection of the healthy, from becoming afflicted.

SCAB.

Sheep owners in Potter, Clark, Deuel, and Codington counties, are well aware that this disease exists, in their respective counties. It is but right and proper, that their fellow flockmasters in other parts of the state, should also be made aware of this disagreeable fact.

Through a loose method of purchasing sheep, that are shipped into this state from other states, by commission men and sheep traders, scab has been introduced into the above named counties. Had proper steps been taken to stamp out the disease on its first appearance, hundreds of sheep would have been saved, in each of the counties named. If those who owned the first diseased flock were the only sufferers, the public in general, might let the matter rest right there. But through the carelessness of one or two men, inasmuch as they refuse or neglect to carry out the orders of health officers; we know of some cases where flocks have been quarantined by the county boards of health, but in a few days the owners of the diseased animals, not only sheep, but also in cases of Glanders among horses, have broken the quarantine and allowed their diseased animals to visit the pastures and stock of their neighbor, and from there to their neighbor's neighbor, till nearly all the flocks in a township have become innoculated with the disease. In such cases, the just and the unjust, suffer alike. Where it is to stop, no man can tell. If there is not a vigorous enforcement of the law, regarding scabby sheep, the flocks of some counties are apt to be exterminated. The only hope that owners of healthy flocks have, lies in the rigid enforcement of the law, against those who have diseased animals in their possession.

Disease.—There are three forms of scab in sheep, viz: [1]"Head Scab (*sarcoptic*), Foot Scab (*symbiotic*) and Common Scab (*psoroptic*). Each form in which the disease appears is caused by three different species of insects. "The form in which the disease appears in this state is known as common scab (*Psoroptic*) caused by the scab or itch insect [2]"*Psoroptes communis*, Furst., var. Ovis." This insect may very often be seen by the unaided eye, in the wool near the edges of the scabs.

When we consider how suddenly they attack a healthy sheep, how rapidly they increase in numbers, and how destructive they become, when allowed to go on with their destructive work, we then see the necessity of taking early steps for their extermination.

1, Williams' Surgery, p. 696. 2, Bu. of Animal Industry, Parasites of Sheep, p. 56.

[3] "The following table furnished by Gerlach will show how rapidly this parasite increases:

GENERATION.	DAYS.	FEMALES BORN.	MALES BORN.
1st,	15,	10,	5
2nd,	30,	100,	50
3rd,	45,	1,000,	500
4th,	60,	10,000,	5,000
5th,	75,	100,000,	50,000
6th,	90,	1,000,000,	500,000

SYMPTOMS.—The first symptom noticed is the sheep rubbing and biting themselves; after a while the wool begins to look ragged; later on patches of wool fall off from the body, in other places it is easily removed by the hand, and finally the whole fleece drops off. The sheep then is in a debilitated condition. The continual itching causes loss of rest, thus the way is opened for other diseases, and death may take place in from three to six months from the time they were first attacked by the destructive parasite. Even if there be no deaths, the very fact, that the fleece of a scabby sheep, is decreased in value, should induce sheep owners to work hard for the destruction of the parasite.

CONTAGION:—When infected sheep are allowed to go at large, they are continually spreading the disease by dropping tags of wool, rubbing against fences, and so on. Thus healthy sheep going over the same ground become infected. The parasite can live about the fences, or sheds, for, from two to three weeks after they leave the sheep. [4]"Scab is one of the most dreaded diseases of sheep. For the flockmaster who has but few sheep, say fifty or a hundred, the task of treatment and eradication of the scab from the flock is no easy affair; but for him who owns from five to twenty thousand the difficulties to be met are enormously increased. Though the disease may be easily treated so far as one sheep is concerned, still the treatment would only be palliative and would not assure the flockmaster that the disease would not break out again. Treatment, therefore, of a flock in which scab has appeared must be applied to

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3, Williams' Surgery, p. 697.

every individual exposed, and to the sheep pens and Corral in which they have been lodged."

TREATMENT:—This is of two kinds,—preventive and curative. The first important step to take is to remove the diseased animals, from the healthy, the whole flock should be quarantined, so that they may not transmit the disease to healthy sheep.

Dip the whole flock, whether diseased or not, as every animal that has once been exposed to the disease, is unsafe, until they have been thoroughly cleaned and disinfected, by dipping or otherwise.

The sheds, yards, and fences should be thoroughly cleaned and disinfected with a solution of boiling lye, or carbolic acid, after which give a coat of white wash to all the woodwork. Keep the diseased flock in a clean uninfected enclosure for at least one month and to be kept from other sheep 60 days, during which time they should be repeatedly, examined so that, if the first dipping should not have destroyed all the parasites the dip should be reapplied. Sheep that have died should be burned, or in some other way disposed of so that the parasites on the carcass may do no more damage.

Healthy sheep should not be allowed to enter sheds, corrals, pastures or yards, for at least, one month, after the diseased sheep have been removed from the same. From a sanitary point of view, it is a good plan to give all flocks a thorough dipping in some good sheep dip at least once a year, and let that be when the flock has been clipped, at this time, the parasites are easily reached, and the medicine will go further, than when there is a heavy fleece upon the sheep. Of the many dips that are advertized we have seen a few do good work. In Deuel County, the Thymo—Cresol sheep dip has done good work on scabby sheep. [5] "A very effectual dip is a preparation of Arsenic one pound Carbonate of Potash one pound to water twenty gallons." [6]"The chief poisons used in sheep dip are tobacco, arsenic and carbolic acid. Of these tobocco is the favorite, because its use has not been followed by the fatality that has in times past followed the use of arsenic. Carbolic acid is too expensive to be used in large quantities. The

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[4] Bu. of animal industry report Parasites of sheep p 59.

Australian or Rutherford dip, has been very successful and is as follows: Tobacco and flowers of Sulphur one pound each, to every four gallons of water, the tobacco should be steeped in a portion of the water, two or three successive times so as to extract the juice. The leaves or stems may be used; of the latter three times the weight is required, as is needed of the former; a press, or wringer is convenient to squeeze out all the liquor from them. The sulphur should be mixed with some of the tobacco water and stirred until it is of creamy consistency. These ingredients should be added to the required amount of water. During the dipping this mixture should be constantly stirred and a little fresh water added from time to time to replace that lost by evaporation. This dip, should never be used at a higher temperature than 110° Fah. nor lower than 100° Fah. if used during the summer weather and 110° to 120° Fah. in winter. The sheep should remain immersed in it from sixty to ninety seconds."

[7] "Rolopps dip, a mixture sufficient for 100 sheep, is; take 20 pounds of tobacco, steep it with 66 gallons of water for half an hour, heat it to 95° Fah. and add 2½ pounds each of pure Carbolic acid and of potash.

Here is one of the cheapest dips and it is generally effective viz: Mix an infusion of 15 pounds tobacco with 2½ pounds carbolic acid and 13½ pounds of wood tar, pour it into 66 gallons water at 125° Fah., in which 3 pounds soda has been dissolved. Use it at a temperature of 80° or 90° Fah. and repeat in six or seven days."

In fact almost any of the ordinary sheep dips, will kill these parasites, but dips to be effective, should be applied immediately after shearing and reapplied in about eight days from the time of first dipping. Thus the eggs will be hatched and the second dipping will destroy all the young (new comers). It is early treatment, and especially treatment of the preventive sort, that is cheap, easy and profitable, but when this is neglected you are sure to be called on to undertake a more expensive and

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5, Willlams Surgery p 693.

6, Bu. Animal industry parasites of sheep p 61.

7, Rep. of Bu. of Animal Industry parasites of sheep p 64.

unprofitable kind of treatment. We hope this will settle all further inquiries regarding the treatment of scab and other external parasitic diseases of sheep.

LUMPY JAW.

Lumpy Jaw:—(*Actinomycosis*) Though it is only recently, that we have been accustomed to the term Lumpy jaw, (*Actinomycosis*) this disease has been treated by all the old writers, under different names. [8]"The disease is said to be very prevalent in Germany, where it has received various popular names by Agriculturalists and dairy people, whose cattle were so frequently victims to it. In Germany the disease of the bones was known as "Ladendruck," "Ladengeschwulst," "Dicker backen," "Krebsbacken," "Bäckel," etc., etc.

When the tongue or other soft tissues in the mouth were specially involved, the terms "Holzzunge" (*Wooden tongue*), "Hohlgeschwulste," "Schlundbeulen," "Wurm," etc, were applied.

In Italy also the disease is very common, it was popularly considered to be a kind of Glanders and Farcy of cattle. Sometimes they looked upon it as Tuberculosis."

In Great Britian, the disease also exists, Prof. Williams in his work on Veterinary Surgery, speaks of the disease as follows:

[9]"Otseoid Tumors:—These are tumors of irregularly protuberant surface, affecting both the upper and lower jaws of horned cattle, they are generally of a slow, but sometime of a rapid growth, and when so, they possess some malignity (see Ostea—Sarcoma.)" The only treatment that can be recommended is early removal of the tumor and before it has attained any size. If it be of any magnitude no treatment should be attempted, but the animal fed for slaughter."

Prof. George Fleming of London, one of the best known Veterinary writers in the world, in his book, entitled; A New Infectious Disease, written a few years ago, says; [10]"In this country, the disease undoubtedly exist, and in all probability widely and frequently; though its Pathology has not hitherto been ascertained.

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[8] Flemings new Infectious disease p 9.

[9] Williams Surgery p 421.

As already stated, so far as the pathology of this malady is concerned, it is a new disease; as until its histological characters were discovered we were in ignorance of its nature. It has been designated as Scrofula, Tubercule, Tubercular Stomatitis, Milliary Tubercule, Schirrus tongue, Glossitis, Osteosarcoma, Osteoporosis, and many other names, there is every reason to think that this disease has been included in the descriptions of these various affections."

[11]*Actono—Mycosis.* This malignant growth may be classified as a parasitic tumor, consisting of the development of cellular sarcomatous elements, from an irritation caused by the presence of a vegetable parasite—the actinomyces or ray fungus—a radiating or star like vegetable parasitic growth. The botanical position of this fungus is not yet determined, some pathologists going so far as to question its vegetable origin, as it differs in many respects from its congeners. In cattle, the masses or tumors seldom suppurate, and sometimes attain the size of a goose's egg, affecting the tongue, the lower and upper jaws, and it has been discovered in other parts of the alimentary tracks, the lungs, skin, etc" From this time (1884) we have been gradually getting more light on the nature of lumpy jaw, but not until within the last two years have we had very positive claims as to the successful treatment of the disease.

Prof. Flenning, like Prof. Williams, says, that the treatment of this disease belongs to the domain of surgery. The same authority, describes actinomycosis of the bones of the jaw, of the fauces, nasal chambers, larynx, stomach and intestines, udder, lungs, etc.

During the past year the Bureau of animal industry at Washington, D. C., undertook a series of experiments with this disease at the Chicago stockyards, the results of these experiments have been very encouraging to the Bureau, as the officers in charge of the experiments claim that 75 per cent. of

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10, Flemings New Infect disease p 9.
11, Williams Surgery 5th Edition 1884, P. 441.

the animals treated were cured. While the board of live stock commissioners of the state of Illinois, and their veterinary advisers, deny this large percentage of cures. In order to meet the desire of a large number of stockmen who are possessors of lumpy jaw cattle. We will give the Bureau's treatment in full. "[12]The medicine used in treating lumpy jaw in cattle is the iodide of potassium, the dose should never exceed (¼ dram.) for every hundred pounds live weight, the proper dose being from 8 to 12 grams (2 to 3 drams) according to the size of the animal and the extent of the lesion. This dose may be given daily for from 5 to 6 days, when the animal will show slight symptoms of iodism, viz: discharge of thick mucus from the nose and excretion of tears. The manure will become rather dry, but that is easily repaired by giving a dose of Glauber's salts and some bran mash.

This will restore the appetite, and two days after the last dose was given the animal will be ready for another week's treatment, and so on till a cure is affected. If these precautions are taken, no ill effect will result from the treatment, and if properly fed the animal will gain in condition uninfluenced by the medicine. There is, however, a great difference as to the individual effect of the medicine on animals, but any farmer who takes an interest in seeing his stock doing well will easily perceive when it is time for him to stop the medicine, and give the animal a rest for two or three days The medicine is best administered dissolved in water and given by means of a long necked bottle. One dose of medicine is dissolved in one pint of water, the animal is held by the nose and the contents of the bottle emptied into the animal's mouth without fixing or securing the tongue in any way.

Where a man has several head of lumpy jawed cattle to treat, they may not be of the same size and therefore not require the same dose of the medicine. As the farmer or breeder is not usually in possession of a pair of scales sufficiently fine to weigh of such small doses as required, the most convenient way is to have the medicine, which is easily dissolved, prepared in a concentrated solution of the strength 1 to 2 (2 drams of the solution to contain 1 dram of the iodide of potassium.)

The drug must be dissolved in distilled or rain water, as otherwise a precipitate will form from the salts present in common water.

Measure out the exact dose for every animal and pour it into a long necked wine bottle half filled with common water. On ranges and similar places, where a large number of cattle are kept, the easiest way is to keep the affected cattle in a large pen, in one side of which the cattle may be driven one by one and treated. You may stop giving the medicine when the tumor is shrunken to one third its original size, as the rest of it will gradually disappear.

When the bone is affected, treatment is only advisable when the swelling does not exceed the size of a goose egg.

It now remains to decide which cases will prove of financial value for the farmers and breeders to treat. The amount of medicine used in a single case ought never to exceed one pound, equal to an expense of $3. We suppose any steer will be worth that much."

When there is a running sore externally, we have found iodoform dusted over and into the open sore, very useful in drying up and healing the parts, but when using the iodoform externally we reduce the iodide of potash treatment internally about one third. Any stockman can try this treatment for himself and if there are any successes, or failures with the treatment it should be made known as soon as possible. We certainly have considerable faith in the iodide of potassium treatment so far as we have gone.

ANTHRAX.

For several years, there has been considerable loss of cattle from this disease in different counties east of the Missouri river. While there is nothing new to advance in regard to this disease, we propose to call the attention of stock owners to a few facts regarding the best means of preventing the spread of

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12, Bu. of Animal Industry, Chicago Exp. P. 40.

the disease in localities where it has previously made its appearance.

Anthrax: Is a generic term, it applies to a group of diseases of a contageous nature, which manifest themselves under various forms, and under different names. The disease has generally appeared among cattle in this state in the form of splenic apoplexy, and black leg. Cattle kept on low lying lands, such as river bottoms, old lake beds etc., are most subject to the disease, especially when they are kept on such pastures immediately after heavy rains. During the summer of 1891, and 1892, outbreaks of the disease appeared on the Sisseton reservation, where it generally took the form of splenic apoplexy.

SYMPTOMS.

Splenic Apoplexy: There is a sudden loss of appetite, the affected animals stop chewing the cud, sometimes they are taken with shivering fits. The animal becomes weak and is inclined to lay down a good deal. The heart beats violently, there may be a slight flow of mucus from the mouth, a watery discharge from the eyes, and sometimes a bloody discharge from the nose. The affected animals may sometimes be so excited that it is dangerous to approach them. Death may take place in from two to twenty hours, from the time the first symptoms appeared. The symptoms of black leg is as follows: The very best animal in the herd are most liable to attack, generally two or three year olds. The animal becomes stupid and listless, there is considerable pain or pressure about the ribs and loins, the ears become pendent. Soon after you will notice the swelling of one or more limbs, most frequently the fore limbs, swellings may also appear about the loins, head, or neck. The affected animals are always unwilling to move and generally prefer to be in a recumbent position, there is generally complete loss of appetite. The swellings are cold to the touch, and when handled will sometimes make a crackling sound. The animal seems unconscious and soon passes away. After death, there is a dark bloody froth issuing from the mouth and nose, and sometimes from the anus. The above symptoms are familiar to stock-men who have frequently seen the disease.

TREATMENT.

Very little can be done for the animals after the disease and its symptoms have become fully developed. But much may be done in the way of preventing an outbreak, or the spread of the disease after it has made its appearance.

Great care should be taken to see that the carcasses of animals dying from the disease are buried deep under the surface of the ground, or burned to ashes. If buried, the ground over the carcasses should be fenced, so that for at least one or two years, cattle are not allowed to pasture thereon, When the disease makes its first appearance remove the herd to the high land pastures, so that they may not feed on low ground, especially after heavy rains.

The introduction of seatons in the breast, with a little fly blistering ointment is good. And to animals that seem to be affected it is a good plan to give from two to three drams of the Chlorate of Potash once daily for several days. If the bowels are not acting freely, give from one to one and a half pints of Linseed oil and one ounce of Spirits of Turpentine. Shake well together and give as one dose. Should there appear to be a serious attack of any herd by this disease it is advisable to call in some qualified Veterinarian.

This bulletin is issued, not as original matter, but for the purpose in advising stockmen in regard to the disease herein mentioned and in reply to numerous inquires from all parts of the state.

April 26, 189

SOUTH DAKOTA
AGRICULTURAL COLLEGE
AND
EXPERIMENT STATION

BROOKINGS, S. D.

BULLETIN NO. 37.

DECEMBER 1893.

Horticulture and Forestry.

TOMATOES.

DUTCHER, BREED & STORGAARD, BROOKINGS.

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The Bulletins of this Station will be sent free to all citizens of the State who will apply for them.

All letters and other mail matter for the Station should be addressed to the Experiment Station.

TOMATOES.

LEE CLEVELAND CORBETT.

That tomatoes can not be successfully grown and ripened in the open air in South Dakota, is an idea very generally met with throughout the state. But judging from the results of our experiments, during the season of '93, there must have been some fault in the methods of culture pursued by those failing to ripen a paying crop.

There are conditions to be overcome in nearly all climates and the one here is the short season of plant growth. The past summer was perhaps one of average length, yet the period, as shown below, between frosts was too short by over a month. The time at which frosts of spring may no longer be feared is generally between May 25. and June 1. This year our plants were set in the field on May 29, and a killing frost came Sep. 15, thus giving 108 days for plants to grow and mature their fruit, a period altogether too short to expect any fruit to ripen, much less a paying crop, were the seeds planted in the open. The number of days necessary, under favorable circumstances, for a tomato to grow from seed and mature its fruit is one hundred and forty days. But since we have only about one hundred days to depend on, the deficiencey must be made up. How is it to be done ? Surely not by attempting to ward off the fall frosts. The other alternative then is to get the plants far enough advanced before planting them in the field to insure the maturing of the fruit.

SEED SOWING.

There are three sources from which aid in overcoming the difficulty above mentioned may be expected. They are briefly: Time of seed sowing; methods of culture and training; selection for early strains of fruit.

This season no careful experiments were made upon the time of sowing the seed of any one variety, a line of work that will receive attention next year, but from general observation based upon the data of the accompanying table, it is safe to say that there is a time at which the seed should be sown to get the best results.

TABLE I.—*Seed Sowing.*

Variety.	Seed sown.	Set in field.	In bloom.	Fruit ripe.
Earliest of All	Feb. 16	May 29	June 13	July 23
Early Advance	Mar. 17	May 29	June 14	July 27
Early Ruby	Apr. 10	June 3	July 6	Aug. 17
Red Queen	Apr. 18	June 3	July 21	Sep. 11

From the table it will be noted that plants grown from seed planted Feb. 16, ripened their fruit only four days in advance of another lot planted a month afterwards, while a third variety planted twenty-four days after the second was almost that number of days later in ripening its fruit. After making a due allowance for difference in variety, it would appear from this that, in general, March 15, would be a safe date, as earlier planting does not correspondingly advance the ripening season, while later planting appears to proportionately retard maturity. These conclusions are verified by experiments elsewhere.*

INFLUENCE OF TRAINING.

Three methods of treatment were decided upon as shown in the illustration. The plants used were of the same age and variety and had been given the same treatment up to the time of setting in the field. The plants of Plat 1 were allowed to remain upon the ground in the usual manner,—without artificial support. Those of Plat II. were trained by confining the vines within a rack two feet high, eighteen inches square at the bottom and about two feet square at the top. In Plat III. the plants were set two feet apart in the row, and trained to a single stem. All the side shoots were kept off and the main stalk was tied to a light strip of wood, one end of which was inserted in the ground, and the other fastened to a No. 12 wire that had been stretched for the purpose.

*See Cornell University Bull. 45.

Table II. gives the average product of the various treatments, up to and including Aug. 28.

TABLE II.—*Influence of Training.*

Variety, "Early Advance."	Seed sown.	Date of first picking.	Av. No. of fruits per plant.	Av. Wt. of crop per plant.	Av. Wt. of individual fruits.
Plat No. I	March 17	Aug. 1	8.4	1.01	1.92
Plat No. II	March 17	July 27	8.5	1.07	1.89
Plat No. III	March 17	July 28	5.3	0.64	1.94

It shows that normal plants produced more pounds per plant than those trained in either of the other fashions described, but owing to the greater number of plants that can be grown per acre the total yield of the single stem training will be found to exceed that of the normal or rack trained plants.

TABLE III.—*Influence of Training.*—Continued.

Variety—"Early Advance."	Av. No. fruit per plant.	Av Wt. of crop per plant.	Av. Wt. of individual fruits.
Plat I, Ripe fruit	50.9	5.28	1.66
Plat II " "	33.5	3.57	1.70
Plat III " "	16.3	1.32	1.30
Plat I Total (ripe or green)	76.0	6.16	1.32
Plat II "	46.7	4.25	1.55
Plat III "	20.6	1.93	1.40

Table III. gives the total season's product. The part above the division line represents the total yield of ripe fruits, while the part below it gives the total product including both ripe and green fruits. It indicates that much the greater quantity of fruit was produced by the untrained, while the largest proportion of ripe fruits, to the total yield, was produced by the plants trained to a single stem.

The accompanying table, giving the product per acre of the plants trained in the above manner, has been made up from the results of Table II and that part of Table III above the division line; and represents only the ripened product of the different periods. The first period covers the time from first ripening up to and including Aug. 28, and the second the whole season beginning with first fruit ripening and ending Sep. 23.

TABLE IV.—*Yield per Acre of Trained Plants.*

Variety—"Early Advance."	Number of plants per acre.	Yield per plant for first period.	Yield per plant for season.	Yield per acre for first period.	Yield per acre for season.
Plat I	2,722	1.01	5.28	54.98	287.44
Plat II	2,722	1.07	3.57	58.25	194.35
Plat III	5,445	0.64	1.32	69.69	143.75

This would indicate that during the early part of the season the single stem training gave the greatest yield per acre, but that the other systems were best for the whole season. It will be noted that twice as many plants are required to plant an acre for the single stem training as for either of the other methods, thus doubling the first cost both for plants themselves and for setting. It is a question then for each individual to settle for himself whether or not the apparent gain in early production is enough to warrent the necessary increase in cost. If land is valuable and the available area limited, then the upright or single stem system may be favorably considered for the early crop.

RIPE, SUN-RIPENED, AND GREEN SEED.

This line of work was begun last season and it was thought best to continue it, notwithstanding, the fact the field was very thoroughly worked over by Prof. E. S. Goff, of Wisconsin, while he was in charge of the horticultural department of the New York state experiment station at Geneva.*

The plants selected for this work were Dwarf Champions. The ripe fruits from which the seeds were taken were selected Aug. 18, 1892, from typical plants of the variety. The green fruits were selected on the same day and from similar plants; no fruit was taken that gave indication of color, although they were nearly full size. The others were picked July 5th, and allowed to color and ripen in the sun, they were good specimens but perfectly green at the time of picking.

On March 17. following, seeds from each of the three lots were sown in a flat so that the conditions for all should be the same. April 15. the young plants were transferred to thumb-pots, and at this time the plants from the seed of fruits matured on the vines were considered the best. No accurate account was kept of the per centage of germination for the three sets, but it was evident that the naturally ripened seed was strongest. The sun-ripened specimens stood second both in vigor of plants and rate of germination. The seed from green fruits, while low in vitality gave a sparse stand of plants that soon grew to equal the others, and at planting time, June 4, it was impossible to note any difference in the thrift of the three sets. The comparisons of Table V are based on 120 plants from naturally matured seed; 100 plants from the seed of sun-ripened fruits, and 60 from the seed of green fruits.

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*New York Station 3, annual '84, P. 224.
" " " 4, " '85, " 182.
" " " 8, " '89, " 329.
" " " 9, " '90, " 299.

TABLE V.—*Normal, Sun-Ripened and Green Seed.*

Variety—"Dwarf Champion."	Set in field.	First ripe fruit.	No. plants in plat.	No fruits ripened.	Total Weight.		Av. Wt. of fruit per plant.	Av. No. fruits per plant.	Av. Wt. of individual fruits.
					lbs.	oz.			
Plat 1, Normal..................	June 3	Aug 10	120	1616	302	2	2.51	13.4	2.99
Plat 2, Sun ripened............	June 3	Aug 18	100	1595	260	5	2.60	15.9	2.61
Plat 3, Green..................	June 3	Aug. 9	60	947	257	13	4.10	15.7	4.25

The above table records only the ripe fruit of the season ending Sept. 27. From this it will be seen that the plants from green seed gave the first ripe fruit, although the difference was very little in comparison with that recorded in the experiments of Prof. Goff above noted It will also be seen that the product of the plants from green seed, for the season, is considerably in excess of the normal and sun-ripened, both in aggregate weight of product per plant as well as weight of individual fruits. The average number of fruits per plant was not quite equal to that of the sun-ripened, but considerably in excess of the normal.

At the above rates of production the different plats would have given the following yield per acre;—Plat I. 136.64 bushels, Plat II. 141.54 bushels, Plat III. 208.12 bushels, allowing the plants to be set four feet apart each way.

SEEDLINGS VS. CUTTINGS.

The tomato is easily propagated by cuttings and some growers claim that cutting plants are enough superior to seedlings to justify the trouble and expense of keeping over a few plants to take cuttings from for the early crop. If cutting plants are enough superior to justify this trouble in other localities, it is worthy of consideration here where the fruiting season is short.

An experiment along this line was undertaken, and the cutting plants were compared with seedlings of the same variety, and with the parent plant itself. Instead, however, of using plants that had been kept over, hot house grown plants of the variety "Earliest of All," from seed, planted January 16, were used. On April 18, following cuttings were made from the leaders of some thirty good vigorous specimens and planted in the propagating bench of the green-house. The bench is heated by hot water pipes which are arranged beneath it, and is maintained at a temperature of about 68° F. The bed is composed of about three and one half inches of coarse lake sand, underlaid with about one and one half inches of clinkers. No covering sash were used, so the air about the cuttings was not close. Under these conditions the slips were sufficiently rooted in fourteen days to be transplanted to individual pots. The seedling plants used in the test were from the same seed-sowing, and were grown under the same conditions as those from which the cuttings were taken. The plants, from which the cuttings were taken, were retained and set in the field for comparison. The accompanying table records the yield of ripe fruits upon each plat of twenty plants, up to and including Aug. 28.

TABLE VI.—*Seedlings vs. Cuttings.*

Variety—"Earliest of All."	No. fruits till frost.	Wt. of fruit to frost. lbs.	oz	Av. Wt. of fruit per plant.	Av. No. fruits per plants.	Av. weight individual fruits.
Normal	293	38	1	1.9	14.65	2.09
Parent	287	36	4	1.81	14.35	2.00
Cuttings	479	57	13	2.87	24.00	1.90

From this it will be noted that the cutting plants gave much the greater yield, both in number of fruits and in total weight, although the fruits themselves were smaller than those of either the normal or the parent plants. This shows that the cutting plants were decidedly earlier than the seedlings, and, at the same time more productive, a fact that could hardly have been hoped for.*

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*See Cornell University Bulletin 21, 1890; 32, 1891; 45, 1892.

Table VII gives a further record of these plants carrying them to the close of the season, but recording only the ripe fruits.

TABLE VII.—*Seedlings vs. Cuttings.*

Variety—"Earliest of All."	No. fruits for season.	Total Wt. of fruit for season		Av. Wt. of fruits per plants.	Av. No. fruits per plant.	Av. Wt. of individual fruits.
		℔s.	oz.			
Normal	993	98		4.9	49.65	1.57
Parent	1533	146	14	7.3	76.65	1.53
Cuttings	1432	128	13	6.37	71.6	1.43

A study of this table shows that the cuttings were surpassed by those from which they were originally taken, but they maintained their lead over the seedling plants throughout the season.

PRUNED VS. NORMAL PLANTS.

It is a practice among gardeners to clip the top of tomato plants to save the labor of transplanting, and to make them shorter stemmed and better suited for planting in windy districts. What influence, if any, has this practice upon the fruiting of plants so treated ?

April 18. a number of plants were pruned by cutting off some five inches of the top. Twenty of these plants were set in the field May 29, together with a like number from the same seed sowing and which had been treated the same in all respects except that they had not been cut back.

TABLE VIII.—*Pruned vs. Normal.*

Variety—"Earliest of All."	Seed sown.	First fruit ripe.	Av. No. fruits per plant.	Av. Wt. of fruit per plant.	Av. Wt. of individual fruits.
Normal	March 17	July 23	14.65	1.9	2.09
Pruned	March 17	July 28	14.35	1.8	2.00
Normal, for season	March 17	July 23	49.65	4.9	1.57
Pruned, " "	March 17	July 28	76.65	7.3	1.53

Above the division line the table indicates the yield of these plants up to and including Aug. 28, and below it that of the whole season. A comparison of the two parts of the record shows that the pruned plants received a check that they did not recover from until after August 28, but during the later part of the season they over-took and out-did the normal plants.

VARIETIES.

Little can at present be said upon the varieties best suited to our state, but the following brief list, giving the earliness and character of fruits covers the varieties under observation this year. We plan to increase the work of tomato culture along all lines next season, but particularly upon the adaptation of varieties:

Variety.	No of days to first ripe fruit	Remark.
Early Advance	135	Green about stem and inclined to crack.
Dwarf Champion	145	Ripens evenly, good grower, handles well.
Early Ruby	130	Do.
Early Minnesota	173	Lateness due to time of planting.
Earliest of All	188	Do.
Red Queen	147	Not quite up to standard.
Extra Early	160	Lateness due to time of planting. Cracks.
Yellow Fig	110	Small size, suited to pickling.
White Peach	121	Small and not prolific.
Red Cherry	119	Too small for profit. Early and prolific.
Yellow Cherry	123	Do.

ENEMIES AND DISEASES.

Crickets and Grasshoppers.—The fruits, after reaching full size and becoming partly colored, were in some cases attacked by the "Snowy Cricket" and eaten sufficiently to render them unfit for market. Grasshoppers were also found associated with the cricket in these injuries, but whether or not they first break the skin of the fruit is not known; certain it is, however, that both relish the suculent fruit of the tomato.

No treatment or preventative measures can at present be recommended, although several are under trial.

Rot.—During the early part of the fruiting season a small per centage of the fruits were affected with the rot (*Macrosporium, sp.*) but it was not severe enough to warrant any considerable outlay of time or money to prevent it. The short period for ripening together with this rot seem to be the only drawbacks that have attracted the attention of successful tomato growers of the state.

Upon plants trained either in racks or to a single stem the injury was less than upon those left to themselves in the ordinary manner. The disease is apparently augmented by the fruits coming in contact with the soil.

Treatment.—As a preventative measure train the plants so the fruit cannot come in contact with the soil. The raking and burning of all dry and decaying material in the fall after the crop has been gathered has been suggested. But since the disease works on the leaves as well as the fruit it is probable that Bordeaux mixture will be found an efficient preventative.

Œdema.—The tomato plants in the green-house, which are being grown for the winter fruits, developed the phsiological trouble described by Prof. Atkinson of Cornell University as the "Œdema of the Tomato."*

In the case under consideration it was brought on by transferring the plants from pots in which they had been kept quite dry, to the fresh soil of a green house bench which was thoronghly wet after the plants were transplanted. For the purpose of forcing them the soil was kept warm and moist, until this disease made its appearance, when the watering was immediately reduced to the minimum. In a short time the plants began to improve, but not without the loss of some of the lower leaves. As the improvement progressed the amount of water was increased in proportion to the demands of the plants.

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*See Cornell University Station bulletin, 53.

The chief damage to the crop appeared in the fruits which were apparently rotting, and ripened some days in advance of specimens of the same cluster not so injured. The discoloration and shrunken appearance of the fruit, upon close examination revealed neither bacteria nor mycelium threads; and as it did not spread from fruit to fruit, even upon the same plant, and has not made a second appearance it must be attributed to the Œdema of the fruit.

CULTURAL SUGGESTIONS.

A few remarks of a general nature may serve to bring the subject of tomato growing before you in a clearer light.

Seed Sowing.—Sow the seed, not later than March 15, about half an inch deep, either broadcast or in drills. Firm the soil well over them and moisten, maintain a temperature of about 70° F. to insure rapid germination of the seed; keep the young plants growing vigorously; transplant them often to make them "stocky," each time giving them more room. A good plan is to transplant the young plants from the seed bed as soon as they get the first pair of true leaves, setting them in pans or boxes so they shall stand nearly three inches apart. Allow them to remain in this conditions for three or four weeks and transfer to four inch pots or to old vegetable cans, from which both bottom and top have been melted. Then you have a hollow cylinder of tin into which the dirt may be packed, setting a plant in each can at the same time; allow them to grow in the cans until time to set in the field.

Setting in the Field.—At planting time lift the cans upon a piece of tin, an old shingle or anything that can be easily slid under them to prevent the earth from being disturbed about the roots. Have holes dug to receive the plants and slip them from the cans disturbing the earth as little as possible; if the plants have been watered four to six hours before setting, they can be removed without breaking the ball of earth. If the work is carefully done the plants will suffer none from the transfer, and no water need be used at time of planting. It is, however, better to do the work in the afternoon as the plants are thus not necessarily exposed to the sun.

If the plants are "leggy" or drawn, trim off the lower leaves leaving only about six inches of the topmost part bearing leaves. Set the plants, thus treated, in a trench about six inches deep at one end and eight at the other, making it in the direction of the row and of a length sufficient to receive the plant. Place the ball of earth upon the roots of the plant at the deeper end of the trench and allow the top to project above ground at the other, draw the dirt over the plant in this condition and the operation is complete. The advantages gained by this treatment are that a greater root system is soon supplied to the plant, because the portion of the stem buried in the trench will soon take root. A second, and perhaps greater, advantage is that the leaf surface is greatly reduced and only a small portion is thus left exposed above the surface of the ground. Plants thus treated need no protection and are not broken by the wind. The damage by the wind is one of the great drawbacks to setting large plants, but this method will overcome the difficulty and will not retard the maturity of the fruit.

CULTURE.—Clean culture is the next important requirement to success and rapid growth. Cultivate shallow, not more than two inches deep, and as often as once a week. This accelerates growth and tends to reserve the moisture of the soil by preventing evaporation.

SUMMARY.

1. There is not enough gain to warrant the additional trouble and expense of sowing tomato seeds before March 1, and for the ordinary field crop they should not be planted later than the middle of March.

2. Single stem training makes the crop earlier but reduces the quantity materially.

3. Seeds from green fruits gave larger fruits and a greater weight of fruit per plant than sun-ripened or normal.

4. Cutting plants are decidedly earlier and more productive during the early part of the season than normal or parent plants.

5. Pruning plants before setting in the field retards maturity of the fruit.

6. The three best varieties tested were Dwarf Champion, Early Ruby, and Early Advance.

SOUTH DAKOTA
AGRICULTURAL COLLEGE
AND
EXPERIMENT STATION

BROOKINGS, S. D.

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Department of Agriculture.

FEEDING WHEAT TO HOGS.

DUTCHER, BREED & STORGAARD, BROOKINGS.

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FEEDING WHEAT TO HOGS.

E. C. Chilcott.

QUESTIONS ASKED.

This experiment was undertaken to answer the following questions:—

1. Can the farmers of this state realize more from their wheat by feeding it to hogs, than by selling at present prices for wheat and hogs?

2. Can wheat be profitably fed without some other food to form a balanced ration?

3. Will it pay to grind wheat as food for hogs?

4. How does wheat compare with corn and peas as food for hogs?

5. How does the quality of pork made from wheat compare with that made from corn, peas, and mixed food?

6. How does the average daily gain of hogs fed on an exclusive diet of wheat, corn or peas; compare with that of hogs fed on mixed foods?

7. When should fattening begin and how long should it continue?

ANSWERS OBTAINED.

The answers obtained from this experiment are as follows:—

1. Hogs, averaging about 100 ℔ in weight, can be purchased near Sept. 1st at $4.50 per hundred live weight, fed three months on nothing but wheat, water, ashes and salt, and an occasional handful of hay or corn fodder, butchered and sold Dec. 1st for $5.50 per hundred dressed; and will return from 56 to 58 cents per bushel for wheat consumed, without allowing anything for manure, or labor in caring for hogs.

2. At present prices wheat can be profitably fed as an entire ration, but it would undoubtedly *pay better* to mix it with some other food, particularly during the earlier stages of fattening.

3. Hogs fed on ground wheat made a more rapid and uniform gain, and produced pork of rather nicer quality; but they also consumed more food than those fed upon whole wheat. Those fed ground wheat required 4.81 pounds of wheat to produce one pound of gain, while those fed whole wheat required 4.91 pounds to make the same gain. Ground wheat brought 58 39 cents per bushel, while that fed whole brought 55.83 cents per bushel, a difference of only 2.56 cents per bushel. This would hardly pay for grinding, but considering the better quality of the pork and greater weight, it would probably pay to grind, if it could be done without much extra cost.

4. Ground wheat brought 58.39 cents, whole wheat 55.83 cents, peas 65.36 cents, and corn 60 cents per bushel, on an average, for all the grain consumed during the entire experiment, continuing for 90 days. Hogs fed on peas did much better, in proportion, during the first part of the experiment than they did during the latter part, which would indicate that peas are not as good for a complete ration for a long period as either wheat or corn.

5. The quality of the pork made from corn and ground wheat was about equal, and was superior to that made from

whole wheat, peas or mixed food. That made from mixed food was the fattest (see cuts).

6. The average daily gain of hogs fed on peas was 1.21 pounds, on whole wheat 1.12 pounds, on ground corn 1.40 pounds, on ground wheat 1.32 pounds; and on mixed foods 1.61 pounds.

7. This question was not settled, but it was very plainly demonstrated that a considerably larger return per bushel for food consumed would have been realized if the hogs had been sold at the end of the second period (October 28th). This was particularly true of Lot I, fed on peas. The decrease in rate of gain in proportion to food consumption for those fed cornmeal and wheat was no greater than could be accounted for by the natural result of increased weight and age.

Better results would undoubtedly have been obtained if the change from mixed food and plenty of exercise to close confinement and a single article of food, to which they were not accustomed, had been made gradually; as the number of pounds of food required for a pound of gain was greater during the first period than during the second, whereas, it should have been less.

This question will be made the subject of future experiments.

HISTORY.

On the 5th day of September eight pigs were selected from those raised on the College Farm. Four of them were pure bred Poland Chinas, four months and fifteen days old. The other four were crossbred Duroc Jersey and Poland China, and were four months and twenty-three days old. They were divided into four lots, known as Lot 1, II, III and IV. Each lot consisted of one Poland China and one crossbred pig.

As will be seen in the tables of weights, there was quite a difference in weight of the several lots. This could not be avoided without placing two of the same breed together, which we did not deem it advisable to do. All the pigs seemed to be in good health throughout the experiment. One of those in Lot I, had a malformation of the lower jaw-bone, which probably interfered somewhat with its eating, and possibly affected its gain, but as they were given all they would eat, the mere fact of its not being able to eat quite as fast as its mate did not necessarily prevent it from getting all it wanted to eat, and as the malformation was not such as to interfere with its grinding its food, it does not seem probable that the results would be materially affected by this slight defect. With the possible exception above noted, all the pigs were in good physical condition and a fairly even lot.

Up to the time of beginning this experiment the pigs had been well fed upon swill, consisting largely of kitchen slops, sour milk and whey, with some corn and peas. They also had the run of a good pasture, part of the time, and had been fed rape when not at pasture.

At the beginning of the experiment each lot was put into a small pen in the hog-house, having a small out-door yard attached. Each lot was allowed to eat what it would of hay and early cut corn fodder (without ears). They all had free access at all times to salt and hardwood ashes.

The grain for each of the several lots was soaked in cold water. Each lot was provided with a separate tub in which enough grain to last for several days was placed, and enough water, was added, to not only thoroughly moisten the grain; but to furnish all the water needed by the hog. From time to time more grain and water was added as occasion required. An accurate record was kept of the weight of all grain put into the tubs and the supply was so regulated that they would be emptied at the expiration of each period.

Lot I was fed entirely upon Canada field peas, unground.

Lot II was fed upon spring wheat of rather poor quality, unground.

Lot III was fed upon, Dakota grown, Dent corn, ground.

Lot IV was fed upon spring wheat, same quality as that fed to lot II, ground.

The pigs were all given all the food they could be induced to eat. Each lot was weighed once a week, as will be seen by reference to table of weights.

This experiment began on the 5th day of September and closed on the 6th of December, but as the supply of food was greatly reduced for the last four days, I have used ninety days as the actual feeding term instead of ninety-two, which was the time that really elapsed between the beginning and ending of the experiment. This term was subdivided into three separate periods.

The first period began Sept. 5th and ended Sept. 30th, twenty-five days.

The second period began Sept. 30th and ended Oct. 28th, twenty-eight days.

The third period began Oct. 28th and ended Dec. 4th, thirty-seven days.

Table of Weights and Gains for Entire Term.

Date of weighing.	Number of days.	Lot I.			Lot II			Lot III			Lot IV.		
		Weight, pounds.	Gain,—pound.	Daily average,—pounds.	Weight,—pounds.	Gain,—pounds	Daily average,—pounds.	Weight,—pounds.	Gain,—pounds.	Daily average,—pounds.	Weight,—pound.	Gain,—pounds.	Daily average,—pounds
September 5th	..	164	.	....	174	..	....	191	..	....	205	..	....
“ 13th	8	182	18	2.25	191	17	2.12	215	24	3.00	223	18	2.25
“ 16th	3	192	10	3.33	198	7	2.33	215	.	....	229	6	2.00
“ 23rd	7	207	15	2.14	213	15	2.14	240	25	3.56	240	11	1.56
“ 30th	7	224	17	2.43	226	13	1.86	256	16	2.28	263	23	3.28
October 7th	7	246	22	3.14	245	19	1.71	278	22	3.14	288	25	3.56
“ 14th	7	273	27	3.86	273	28	4.00	305	27	3.86	315	27	3.86
“ 21st	7	290	17	2.43	287	14	2.00	329	24	3.43	330	15	2.14
“ 28th	7	310	20	2.86	304	17	2.43	344	15	2.14	350	20	2.84
November 4th	7	328	18	2.57	322	18	2.56	370	26	3.71	375	25	3.56
“ 11th	7	343	15	2.14	330	8	1.14	398	28	4.00	390	15	2.14
“ 18th	7	355	12	1.71	343	13	1.86	411	13	1.86	406	16	2.28
“ 25th	7	367	12	1.71	358	15	2.14	425	14	2.	420	14	2.
December 2nd	7	383	16	2.28	375	17	2.43	452	27	3.86	438	18	2.56
“ 6th	4	382	-1	-.25	377	2	.50	444	-8	-2.	443	5	1.25
Average daily gain, pounds	..	....	..	2.42	....	..	2.25	....	..	2.81	....	..	2.64
“ “ “ per head	..	....	...	1.21	....	..	1.12	......	..	1.40	....	...	1.32

Lot V consisted of two pigs, one Duroc Jersey and Poland China crossbred, and one Poland China. This lot weighed 229 ℔ on Sept. 5th. It was fed on mixed food, consisting largely of kitchen slops, sour milk and whey; with some corn, peas, and wheat. No record was kept of the amount of food consumed, as much of it was of such a nature that it would be impossible to place any value upon it. This lot was not weighed again until Dec. 6th, when it was found that it weighed 520 ℔, having gained 291 ℔ in ninety days, or 3.23 ℔ per day for the lot, or 1.61 ℔ per head per day.

This is a better gain than was made by any other lot, which would indicate that a mixed diet is better than any one kind of grain, as an entire ration.

Table of Gains, by Periods, per Day, per One Hundred Pounds, and per Bushel of Food Consumed. Consumption of Food by Periods per Day and per pound of Gain.

LOT I.—PEAS.

	No. of days.	Increase in weight.		Feed consumed.		Pounds feed for 1 ℔ gain.	Gain for 100 ℔ feed.	Gain per bushel of feed.
		For period.	Per day.	Per period.	Per day.			
1st Period...............	25	60	2.40	202	8.08	3.37	29.67	17.90
2nd "	28	86	3.07	283	10.10	3.29	30.39	18.23
3rd "	37	72	1.95	433	11.70	6.01	16.63	9.98
Term	90	218	2.42	918	10.02	4.21	23.75	14.25

LOT II.—UNGROUND WHEAT.

	No. of days.	Increase in weight.		Feed consumed.		Pounds feed for 1 ℔ gain.	Gain for 100 ℔ feed.	Gain per bushel of feed.
		For period.	Per day.	Per period.	Per day.			
1st Period...............	25	52	2.08	255	10.02	4.90	20.40	12.24
2nd "	28	78	2.78	349	12.46	4.47	22.37	13.42
3rd "	37	73	1.97	393	10.61	5.39	18.55	11.13
Term	90	203	2.25	997	11.07	4.91	20.36	12.22

LOT III.—CORN MEAL.

	No. of days.	Increase in weight.		Feed consumed.		Pounds feed for 1 ℔ gain.	Gain for 100 ℔ feed.	Gain per bushel of feed.
		For period.	Per day.	Per period.	Per day.			
1st Period...............	25	65	2.60	291	11.64	4.47	22.37	12.53
2nd "	28	88	3.14	385	13.75	4.37	22.88	12 81
3rd "	37	100	2.70	483	13.05	4.83	20 70	11.59
Term	90	253	2.81	1159	12.77	4.58	21.83	12.22

LOT IV.—GROUND WHEAT.

	No. of days.	Increase in weight.		Feed consumed.		Pounds feed for 1 ℔ gain.	Gain for 100 ℔ feed.	Gain per bushel of feed.
		For period.	Per day.	Per period.	Per day.			
1st Period...............	25	58	2.32	288	11.52	4.96	20.16	12.09
2nd "	28	87	3.10	366	13.07	4.20	23.80	14.28
3rd "	37	93	2.51	490	13.24	5.26	19.01	11.40
Term	90	238	2.64	1144	12.71	4.81	20.79	12.49

LOT V.—MIXED FEED.

	No. of days.	Increase in weight.		Feed consumed.		Pounds feed for 1 ℔ gain.	Gain for 100 ℔ feed.	Gain per bushel of feed.
		For period.	Per day.	Per period.	Per day.			
Term	90	291	3.23	....	....	......	......	......

This table deserves careful study, as it shows not only the relative value of the different foods; but also the number of pounds of the different foods required to produce a pound of gain during the several periods.

The principal object of this experiment being to determine the feeding value of wheat, to the average farmer, it was thought best to conduct the experiment under conditions, as nearly as possible, corresponding to those that would exist on the average farm.

There are, probably, comparatively few farmers in the state, engaged in grain raising, who would be likely to have on hand, at thrashing time, a large enough number of hogs to consume any great amount of wheat. If wheat did not bring more than fifty cents a bushel at harvest time, and hogs weighing from 50 to 100 ℔ each could be bought for $4.50 per hundred live weight, the farmer could go into the market and purchase such hogs and start, about Sept. 1st, feeding them on wheat alone, under substantially the same conditions existing during this experiment, with a fair prospect of realizing from 55 to 60 cents per bushel for his wheat. It was for this reason, that it was not considered best to place the hogs upon a preliminary diet, composed partly of the food that it was intended should constitute their entire diet, in order to accustom them to it, before they were placed upon that diet exclusively.

It will be noticed that each lot gained less per day, and per hundred pounds of food consumed, during the first period than during the second, whereas, according to the well established rule, that "rate of gain decreases as weight increases" they should have gained more, with a less proportionate consumption of food, during the first, than the second period. The most reasonable explanation of this circumstance is, that it was caused by the sudden change from plenty of exercise and a mixed diet to close confinement and a single article of food. Whenever practicable, such a sudden change should be avoided, but it would not always be possible to do so. The results of this experiment are therefore safer as a guide to the practical farmer than they would have been, had the conditions been such that he could not comply with them.

During the first period one pound of peas was equal to 1.45 pounds of unground wheat, 1.32 pounds of corn meal, or 1.47 pounds ground wheat. During the second period one pound of peas was equal to 1.36 pounds of unground wheat, 1.33 pounds of corn meal, or 1.28 pounds of ground wheat. During the third period one pound of peas was equal to .90 pounds of unground wheat, .80 pounds of cornmeal, or .88 pounds of ground wheat. This would seem to prove that while peas are a valuable food for young growing animals, they are not as well adapted to form an entire ration as either corn or wheat. It should be remembered, however, that after the peas had become distasteful to the hogs there was an unavoidable waste in feeding them; which, undoubtedly, made the consumption of food during the third period appear larger than it really was. This consideration would not, however, affect the daily gain, which fell off far more during this period than did that of the hogs fed upon corn meal, or ground wheat.

During the first period one pound of corn meal was equal to 1.10 pounds of unground wheat, or 1.11 pounds of ground wheat.

During the second period one pound of cornmeal was equal to 1.02 pounds of unground wheat, or .97 pounds of ground wheat.

During the third period one pound of corn meal was equal to 1.11 pounds of unground wheat, or 1.09 pounds of ground wheat.

From this we see that the relative meat producing values of unground wheat, ground wheat and corn meal remained reasonably constant throughout the entire term of feeding.

When we come to consider the relative daily gains, and food consumption, it will be seen that while that of those fed corn meal, and ground wheat remained reasonably constant, there was a marked falling off; in both food consumption and daily gain, in those fed unground wheat. As the object in feeding grain to hogs is to realize a profit on each pound of grain consumed, therefor, the more grain consumed, provided the ratio of consumption to gain remains the same, the greater the profit. It is, therefore, evident that while ground wheat and corn meal were about equal, pound for pound, whole wheat was inferior to either of them when fed alone for three months.

FIRST PERIOD.—TWENTY FIVE DAYS.

	Av. weight at end of period.	Av. daily gain in live weight during period.	Av. daily amt of dry matter in food consumed during period.	Av. amt. of dry matter in food consumed for each pound increase in live weight.
Vermont experiment (41 days)	104	1.28	3.16	2.47
Lot I, peas	112	1.20	3.55	2.96
Lot II, unground wheat	113	1.04	4.40	4.31
Lot III, ground corn	128	1.30	5.12	3.93
Lot IV, ground wheat	132	1.16	5.06	4.35

SECOND PERIOD.—TWENTY-EIGHT DAYS.

	Av. weight at end of period.	Av. daily gain in live weight during period.	Av. daily amt of dry matter in food consumed during period.	Av. amt. of dry matter in food consumed for each pound increase in live weight.
Vermont experiment (39 days)	160	1.40	4.65	3.32
Lot I, peas	155	1.53	4.44	2.90
Lot II, unground wheat	152	1.39	5.48	3.98
Lot III, ground corn	172	1.57	6.04	3.84
Lot IV, ground wheat	175	1.55	5.74	3.69

THIRD PERIOD.—THIRTY-SEVEN DAYS.

	Av. weight at end of period.	Av. daily gain in live weight during period.	Av. daily amt of dry matter in food consumed during period.	Av. amt. of dry matter in food consumed for each pound increase in live weight.
Vermont experiment (33 days)	202	1.31	5.12	3.96
Lot I, peas	191	.98	5.14	5.29
Lot II, unground wheat	188	.99	4.66	4.74
Lot III, ground corn	222	1.35	5.73	4.25
Lot IV, ground wheat	221	1.25	5.82	4.63

As before mentioned, there is a well established rule, that "the greater the weight the less the rate of increase." In order to test this rule the Vermont Experiment Station conducted a series of experiments, the results of which are reported on page 120 of the Fourth Annual Report of that Station.

As the weight of hogs at close of periods, and the length of periods II, III, and IV of that experiment, correspond aproximately with the first, second, and third periods of our experiment, the accompanying table was prepared for the purpose of ascertaining, if possible, how much of the decrease in rate of gain during the third period was the natural result of increased weight, and how much the result of confining the hogs to a diet composed of but the one kind of food.

The pigs in the Vermont experiment were fed as follows:—

"The feed in general consisted of six quarts of skim milk per day and three quarters of a pound of either corn meal or middlings. This was given each day of the test. As the pigs grew older whatever more food they wanted was made up of a mixture of one part by weight of wheat bran and two parts of gluten meal. The pigs were fed all they wanted, or rather all they could be induced to eat."

This ration was certainly one well calculated to produce the very best of results for a long period, so that we can safely say that whatever decrease in gain, or increase in ratio of consumption to gain, was observed, could only be attributed to the rule above quoted.

Taking the results of the Vermont experiment, then, as a standard, we will now proceed to compare our results with them.

In this table we have calculated the weights and consumption of food *per head* and have reduced the feed to *dry matter*.

The periods in the two experiments do not agree. The first period of our experiment was twenty-five days. The corresponding period in the Vermont experiment was forty-one days. The average weight in the Vermont experiment was 77½ ℔; in our experiment Lot I, 97 ℔, Lot II, 100 ℔, Lot III, 112 ℔, Lot IV, 117 ℔.

The second period in our experiment was twenty-eight days. The corresponding period in the Vermont experiment was thirty-nine days, and the average weight 132 ℔; in our experiment Lot I, 133½ ℔, Lot II, 132½ ℔, Lot III, 150 ℔, Lot IV, 153 ℔.

The third period in our experiment was thirty-seven days. The corresponding period in the Vermont experiment was thirty-three days and the average weight was 181 ℔; in our experiment Lot I, 173 ℔, Lot II, 170 ℔, Lot III, 197 ℔, Lot IV, 198 ℔.

During the first period the advantage was decidedly in favor of the Vermont experiment, as the average weight of their hogs was from 20 ℔ to 40 ℔ less than ours. This will help to account for the greater gains in proportion to food consumption in their experiment during this period. During the second and third periods the average weights in the two experiments agreed much more closely.

Comparative Value of One Pound of Dry Matter for Different Periods for Each Lot.

	Ratio of values.		
	1st and 2nd period,	1st and 3rd periods.	2nd and 3rd period.
Vermont experiment	1:1.34	1:1.60	1:1.19
Lot I	1: .98	1:1.78	1:1.82
Lot II	1: .91	1:1.10	1:1.20
Lot III	1: .98	1:1.09	1:1.11
Lot IV	1: .85	1:1.07	1:1.25

As will be seen from the above table, in the Vermont experiment one pound of dry matter fed during the first period was equal to 1.34 ℔ fed during the second period, or 1.60 ℔, during the third period. One pound fed during the second period was equal to 1.19 ℔ fed during the third period.

In Lot I, one pound fed during the first period was equal to .98 ℔ fed during the second period, or 1.78 ℔, during the third period. One pound fed during the second period was equal to 1.82 ℔ fed during the third period.

In Lot II, one pound fed during the first period was equal to .91 ℔ fed during the second period, or 1.10 ℔, during the third period. One pound fed during the second period was equal to 1.20 ℔ fed during the third period.

In Lot III, one pound fed during the first period was equal to .98 ℔ fed during the second period, or 1.09 ℔, during the third period. One pound fed during the second period was equal to 1.25 ℔, fed during the third period.

In Lot IV, one pound fed during the first period was equal to .85 ℔ fed during the second period, or 1.07 ℔, during the third period. One pound fed during the second period was equal to 1.25 ℔, fed during the third period.

Three points are brought out very strongly by this table:—
1st. The gains, in proportion to food consumed during the first period of our experiment for all four lots, were from two per

cent to fifteen per cent less than for the second period; whereas, in the Vermont experiment, the gain was thirty four per cent greater in the first, than in the second period. 2nd. The gain in proportion to food consumed by Lot I, during the third period, as compared with either the first or second period, was very much less than that of any of the other lots. 3rd. With the two exceptions above mentioned, the relative rate of gain in proportion to food consumption was, reasonably, uniform for all lots and periods, and corresponded closely with the Vermont experiment.

From these facts we must conclude that;—

1. Hogs that have been accustomed to exercise and a mixed diet, should not be shut up, and confined to one kind of food, at once, or without a preliminary feeding period to gradually accustom them to the changed conditions.

2. Although peas gave better returns than either corn or wheat for the first and second periods, they are not equal to either of them as a single article of food for a long period.

3. The decrease in rate of gain of Lots II, III, and IV during the third period was no greater than could be accounted for by increased age and weight. This would indicate that the length of the feeding period had no greater effect upon the feeding value of corn and wheat, than it had upon mixed feed.

Table of Gains and Shrinkage.

	I.	II.	III.	IV.	V.
	Unground peas.	Unground wheat.	Ground corn.	Ground wheat.	Mixed feed.
Total weight, Sept. 5th	164	174	191	205	229
Total weight, Dec. 6th	382	377	444	443	520
Total gain in live weight	218	203	253	238	291
Per cent. of gain to live weight, Sept. 5th	132.92	116.66	132.46	116.09	127.07
Dressed weight, Dec. 6th	316	313	382	370	443
Shrinkage (pounds)	66	64	62	73	77
Shrinkage (per cent.)	17.	17.	14.	16.5	14.8
Equivolent in live weight to $5.50 dressed	4.55	4.54	4.73	4.59	4.68

The above table gives the weights, shrinkage, gains, percentage of gain to weight, percentage of shrinkage, and amount per hundred live weight, realized from selling at $5.50 per hundred, dressed weight, for each lot.

It will be noticed that in the table of gains and consumption the amount of gain to the bushel of food consumed is the same for both Lot II, and Lot III, namely, 12.22 ℔; while Lot IV, gave 12.49 ℔ for each bushel of grain consumed. This estimate was based upon the total gain in live weight for the entire term of feeding.

In the financial statement it will be seen that the price per bushel realized for the grain fed to the several lots was greater for Lot III, than for Lot II, or Lot IV. This seeming disagreement in the two tables is easily explained, when we consider that the estimates in the financial statement are based upon the dressed weight of the hogs, and that the shrinkage, and, therefore, the price per pound live weight actually realized, varied considerably for the several lots.

Financial Statement.

	Lot I.	Lot II.	Lot III.	Lot IV.
	Peas.	Unground wheat.	Ground corn.	Ground wheat.
Total dressed weight, Dec. 6th	316	313	382	370
Received for dressed pork @ 5½c per pound	$17.38	$17.11	$21.01	$20.35
Cost of hogs, Sept. 5th, @ 4½c per pound, live weight	$ 7.38	$ 7.83	$ 8.59	$ 9.22
Balance to pay for feed	$10.00	$ 9.28	$12.42	$11.13
Feed consumed (bushels)	15.30	16.62	20.71	19.06
Price per bushel realized (cents)	65.36	55.83	60.00	58.39

QUALITY OF PORK.

The quality of the pork of all the lots was good. The principal difference being in the proportion of lean to fat meat. As this is largely a matter of individual taste, or the demands of local markets, it would be difficult to decide which lot was the best.

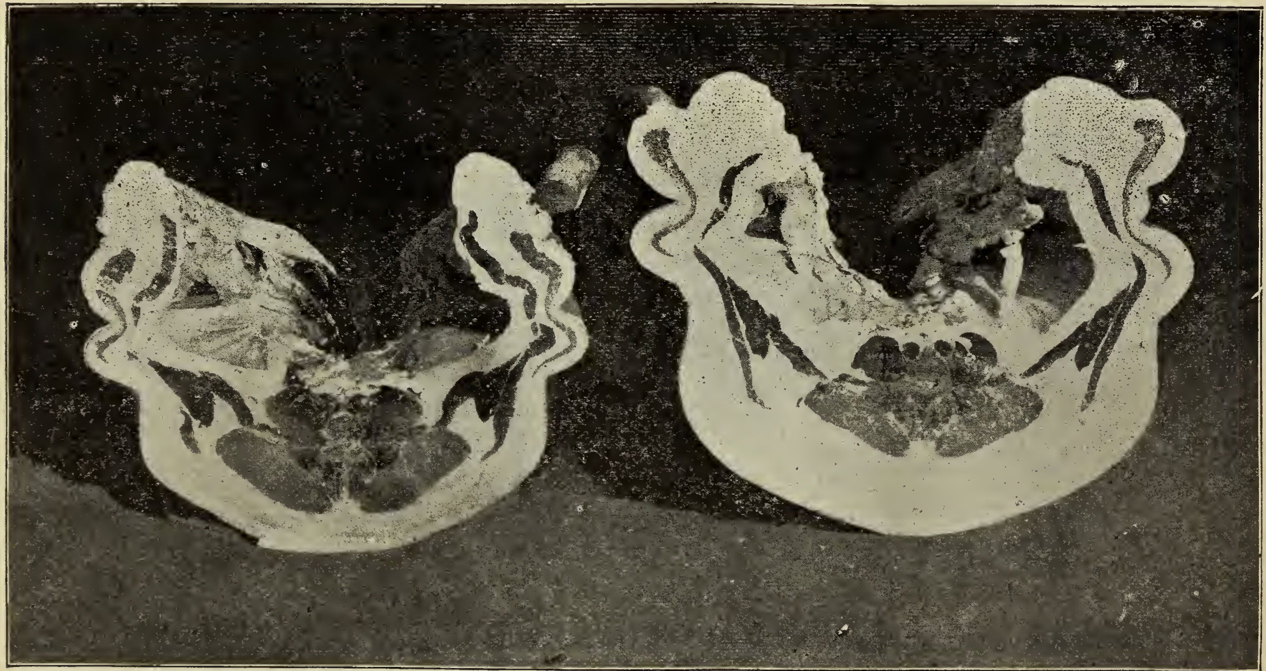
The accompanying cuts are of cross sections taken just back of the kidneys. Care was taken to have the photographs show the exact relative size of the several lots.

Considerable difference will be observed in the proportion of lean to fat meat in the different lots. Lot III, fed on corn meal, not only showed less lean meat in proportion to fat, but there was actually less in amount than in the other lots, if we are to judge from the sections.

Lot V, fed on mixed feed, produced the greatest amount of leaf lard; but the proportion of lean to fat meat was greater than in Lot III.

In Lots I, II, and IV, the proportion of lean to fat meat did not vary more between the several lots than it did between different individuals of the same lot. The proportion of lean to fat meat was greater, and the amount of lard less, in each of these three lots than in Lot III or V.

A study of the accompanying cuts will give a better idea of the quality of the pork, as determined by the proportion of lean to fat meat, than can any written description. Aside from this there was little, if any, difference in the quality of the pork of the several lots.



Lot I.—*Fed on Unground Peas.*

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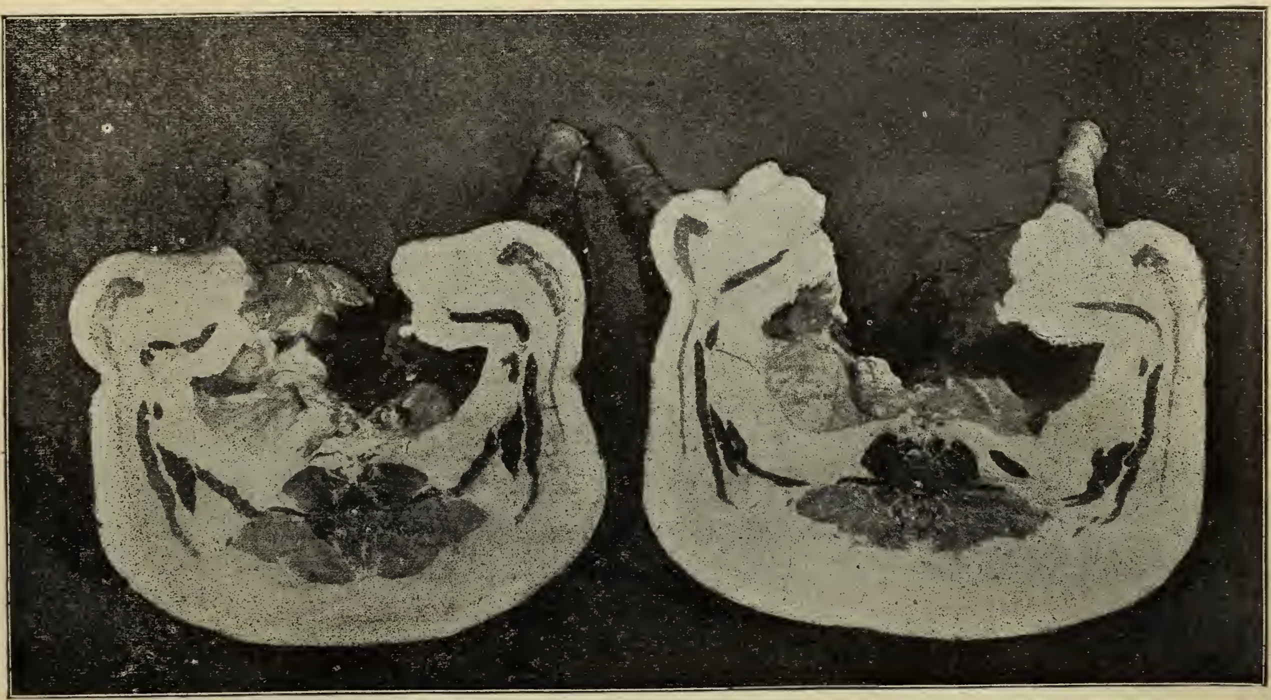
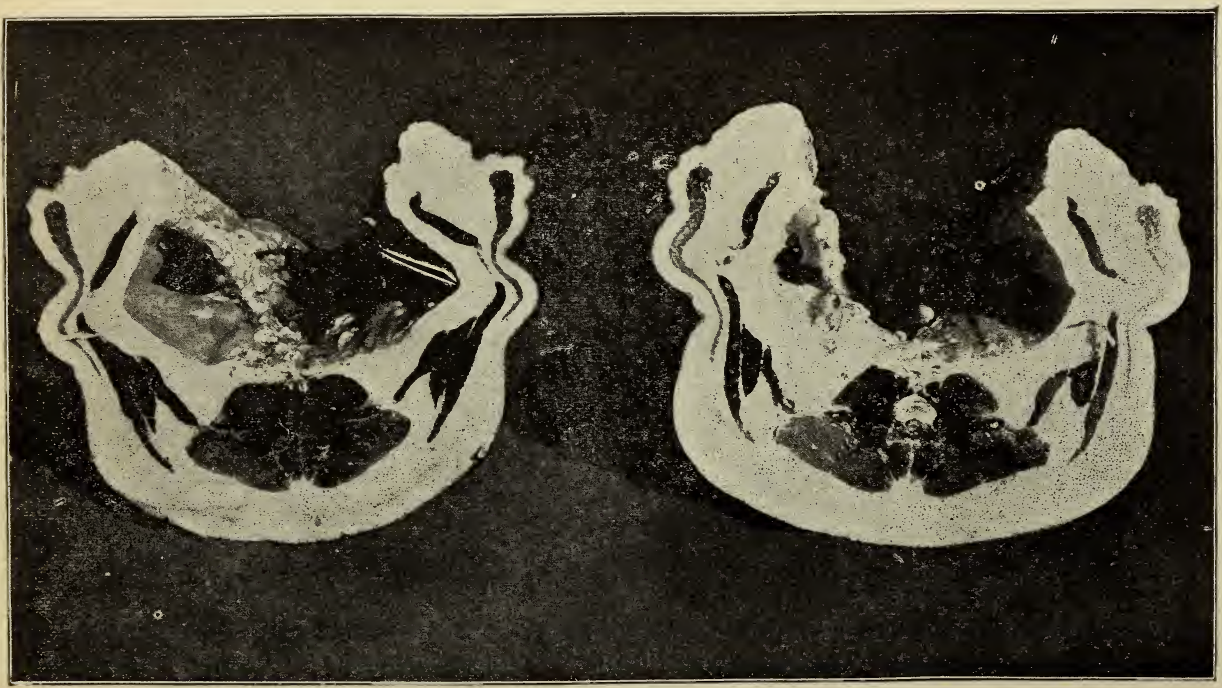


LOT III.—*Fed on Ground Corn.*



LOT II.—*Fed on Whole Wheat.*

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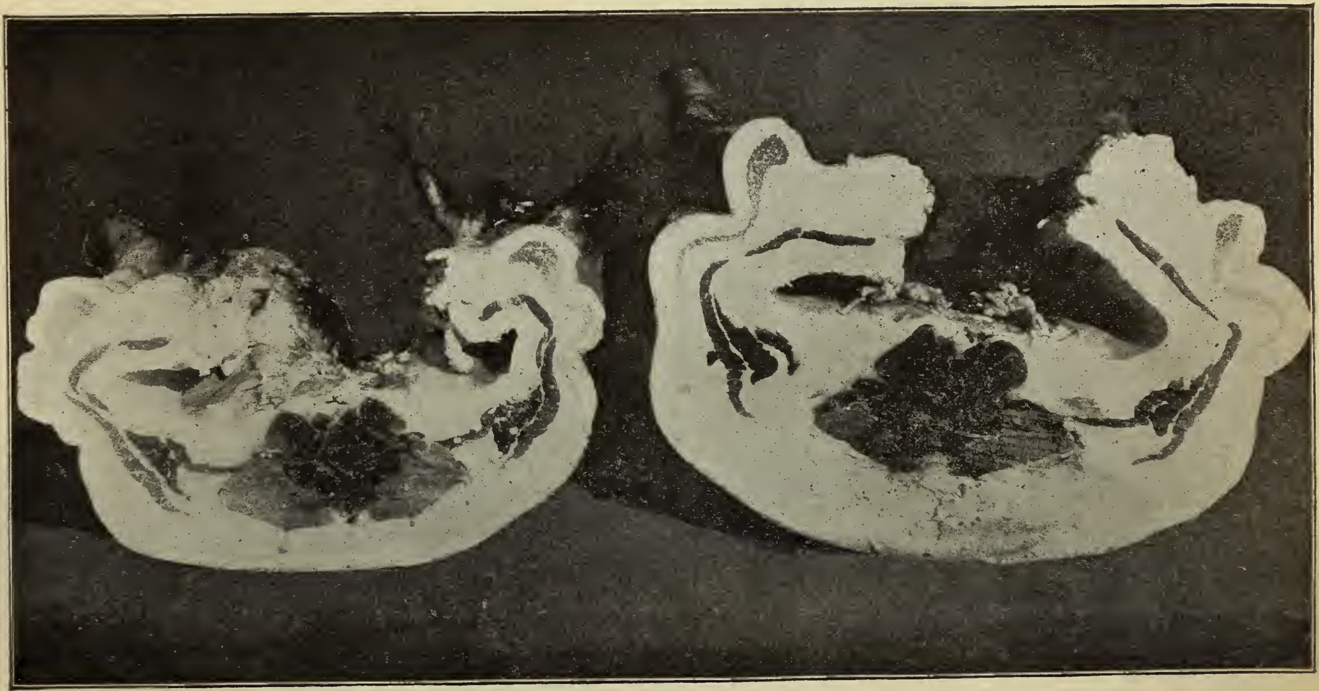
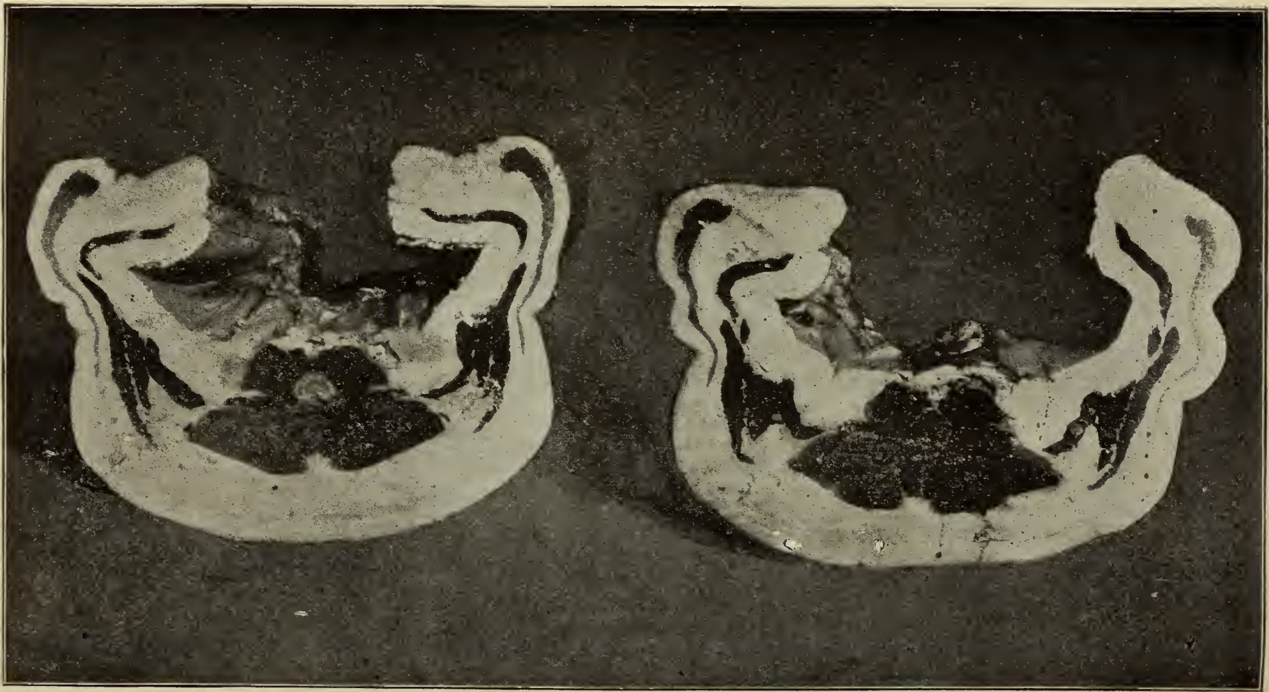


Lot V.—*Fed on Mixed Feed.*



Lot IV.—*Fed on Ground Wheat.*

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AGRICULTURAL COLLEGE
AND
EXPERIMENT STATION

BROOKINGS, S. D.

BULLETIN NO. 39.

FEBRUARY 1894.

Department of Dairy Science.

Milk Tests and Comparison Tables.

DUTCHER, BREED & STORGAARD, BROOKINGS.

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The Bulletins of this Station will be sent free to all citizens of the State who will apply for them.

All letters and other mail matter for the Station should be addressed to the Experiment Station.

DAIRY EXPERIMENT.

A. H. Wheaton, Professor of Dairy Science.

ESTABLISHMENT.

The establishment of a Dairy School in connection with the South Dakota Agricultural College and Experiment Station was authorized by the State Legislature of 1891. The sum of two thousand dollars was appropriated for the erection of suitable buildings and these were built and furnished with all necessary modern appliances and apparatus for instruction and experimental work.

The Department was not furnished with cows, however, until May 15th, 1892, when eight Durham cows were transferred to it from the Department of Agriculture. Three of these were found to be unsuitable for dairy purposes, being inferior milkers and were sold. In March following, there were purchased four Holstein Friesians, two Devons, two Ayrshires, five Guernseys, five Jerseys and one grade cow, making in all twenty-four cows.

All work before this time was conducted with much doubt and uncertainity because the Department had no control of the milk until received; but the results of which are given in this Bulletin with the hope that it may be of some benefit to the dairy farmers of the State as showing what may be done even under most unfavorable circumstances.

Dairying is, comparatively speaking, a new industry in this state, and the writer is alive to the fact that any information giving reliable results under any and all conditions that are applicable to, or at all practical within this State is eagerly sought after by the people. This fact alone has induced the publication of the first part of this Bulletin.

SEPARATOR TEST.

In the spring of 1892, desiring to make some use of the power separator, DeLaval pattern, with a view to ascertaining something in regard to its efficiency as a cream separator, arrangements were made with a farmer living at a distance of five miles from the dairy buildings, who, on April 1st, commenced delivering milk. It was thought that the distance the milk had to be hauled, the time it was usually received, the condition of the cows, stables, etc., would make it a fair average sample of milk such as is generally received at a separating station, or at a creamery managed by the separator process.

The following tables give the results of the work for April and a part of May.

The days when no milk is recorded were days when it stormed or from some other cause the milk was not delivered, but was separated on the farm by a De Laval hand separator, and the cream only was brought to the Station, the results of which are shown in Table No. III:

Table I shows results from milk received in April, 1892, and separated at the Station creamery.

The cream was allowed to ripen on an average of about twenty-six hours and was churned in a revolving barrel, or rectangular churn. The churn was stopped when the butter granules were the size of cracked wheat, the butter milk drawn off, and the butter washed with water at a temperature of 46° F.

It will be noticed that there is quite a difference in the per cent. of cream obtained, which can be accounted for in two ways. The separator was a new one and it was found that a very slight difference in the feed made a very marked change in the per cent of cream obtained. Moreover skimmed milk was used to clear the bowl of all cream at end of each separation, the amount of which was not carefully considered at the time. This also had a marked effect on the time required to churn the cream which was probably due to an excess of milk in the cream of the 1st and 10th inst.

The apparent excess of butter over fat and amount of milk on the 20th and 22nd was due in part to over-ripening of the the cream.

TABLE No. I.

	Pounds of milk separated.	Rate per hour.	Time separated—A. M.	Pounds of cream obtained.	Pounds of cream to 100 pounds milk.	Per cent of butter fat in whole milk,	Per cent of butter fat in skimmed milk.	Per cent of butter fat in butter milk.	Temperature of milk when separated—deg. Fahr.	Temperature cream was ripened—deg. Fahr.	Time required to churn, in minutes.	Temperature churned.	Amount of butter recovered in pounds.
April 1............	365	1,460	9.30	99	27.17	4.2	.2	,4	95	65	59	64	16.50
“ 3............	377	1,331	9.20	54½	14.00	4.	.1	.2	96	65	20	63	18.25
“ 4............	371	1,020	9.45	55	14.85	4.2	.1	2.	98	65	32	64	18.
“ 5............	414	1,129	9.45	66	16.07	4.6	.2	.8	95	70	20	62	21.
“ 6............	400	996	11.00	50	12.50	4.2	.0	1.4	95	70	20	64	18.75
“ 7............	408	951	10.30	55	13.58	3.6	tr	...	94	70	25	64	19.
“ 8............	412	882	10.15	53	12.89	4.2	.1	...	95	70	50	62	19.50
“ 9............	391	977	10.00	77	19.72	4,	.1	.8	92	60	30	62	18.50
“ 10............	408	1,020	9.00	93	22.84	3.5	tr	.2	95	60	80	65	16.50
“ 11............	388	1,164	9.30	64	16.60	3.4	tr	.4	90	60	45	64	15.04
“ 12	403	885	9.45	58	14.40	3 5	.0	.8	90	60	38	63	17.50
“ 18............	393	1,043	11.00	63	16.05	3.6	.3	.7	92	60	45	62	16.75
“ 20............	405	900	10.30	55	13.60	3.6	.3	1	92	60	40	62	20.00
“ 22............	370	924	10.30	67	18.11	4.	tr	.2	96	60	20	62	20.00
“ 25............	415	922	10.40	57	13.73	3.6	.0	.3	94	60	45	62	18.66
“ 27............	407	922	10.10	52	13.79	3.9	tr	.6	97	60	45	63	18.00
“ 30............	416	1,021	10.30	81	19.49	3.6	.1	.1	98	60	45	64	17.83
Totals	6,744	....	......	1,199.50	......	...	..	...	.....	.....	.....	.....	309.99
Averages...........	.....	1,020.4	10.09	....	16.43	3.8	..	...	94.00	63.02	63.02	63.05	......

RECAPITULATION.

Total amount of milk for whole time........................	6,744.00
“ “ “ cream “ “ “	1,199.50
“ “ “ butter “ “ “	309.99
Pounds of butter per 100 lbs milk........................	4.59
“ “ milk per 1 lb butter........................	21.75
“ “ cream to 1 lb butter........................	3.86
“ “ milk to 1 lb cream........................	5.62
Average rate of separation per hour........................	1,020.4
Total lbs of butter fat as per Babcock test........................	256.27
Average lbs butter fat to 100 lbs milk	3.08
Average lbs butter to one of butter fat........................	1.24

Table II shows results from milk received in May from same source as that received in April with conditions about the same, except that the milk was fed to the seperator with less variation owing to a better understanding of its capacity. The speed of the separator was maintained at 7,400 revolutions per minute in both trials.

TABLE NO. II.

	Pounds of milk separated.	Rate per hour.	Pounds of cream obtained.	Pounds of cream to 100 pounds of milk.	Per cent of butter fat in whole milk.	Per cent of butter fat in skim milk.	Per cent of butter fat in butter milk.	Temperature of milk when separated—deg. Fahr.	Temperature cream was ripened—deg. Fahr.	Time required to churn, in minutes.	Temperature churned—deg. Fahr	Amount of butter, in pounds
May 3	442	982	59	13.35	3.9	tr	.2	95	60	45	62	15.50
" 5	439	936	50	11.40	3.7	....	.2	94	60	50	62	16 25
" 7	416	924	67	16.12	3.7	.3	.2	94	62	45	62	17.88
" 10	442	901	61	13.81	4.0	tr	.2	90	62	40	62	18.00
" 12	420	933	63	15.10	3.0	tr	.2	86	64	25	64	17.50
" 14	393	958	65	16.55	4.2	tr	.2	87	60	8	65	16.50
Totals	2,552	....	365	......	....	....	....	...	......	......	...	101.63
Averages	......	939	....	14.39	3.75	.05	.20	91	61.33	35.50	63	16.94

RECAPITULATION.

Average No. of lbs of milk per lb of butter	25.20
" " " " " butter per 100 lbs of milk	3.96
" " " " " cream per 100 lbs of milk	15.10
" " " " " milk per 1 lb of cream	6.62
Whole No. lbs milk	2,552.00
" " " cream	385.00
" " " butter made	101.63
Average No. lbs cream to 1 lb of butter	3.79
Average rate of separation per hour	939.00
Total lbs of butter fat as per daily averages	95.70
Average per cent of butter fat per 100 lbs milk	3.75

The above table does not show as good results as the preceeding one probably owing to the fact that during the first trial the cows were fed hay, bran and shorts while during the second test they were fed on fresh grass in pasture and were fed some bran. This test was made during the most unfavorable time of the whole year for good yields of butter.

Table III shows the results obtained from cream separated by farm separator, the cream being delivered instead of the milk and during the same periods.

TABLE NO. III.

	Weight of cream.	Pounds of butter.	Temperature cream ripened—deg.	Temperature churned—deg.	Time required to churn.	Pounds of cream to pounds of butter.
April 11	62	17.50	60	62	45	......
" 14	53	16.00	60	62	65	......
" 15	57	16.75	60	62	45	......
" 16	57	16.75	60	62	45	......
" 17	57	16.75	60	62	45	......
" 19	78	17.50	60	62	40	......
" 23	64	18.66	60	62	45	......
" 24	64	18.66	60	62	45	......
" 28	58	17.88	60	62	40	......
" 29	58	17.83	60	62	45	......
Total	588	174.30	......	......	......	......
Average	......	......	60	62	46	3.31
May 1	58	15.50	60	62	45	......
" 2	57	15.50	60	62	50	......
" 4	68	16.30	60	62	45	......
" 6	69	17.00	62	62	40	......
" 8	61	17.00	62	62	40	......
" 9	64	17.75	62	64	60	......
" 11	60	17.50	64	64	60	......
" 15	55	17.00	64	64	60	......
" 16	55	16.90	64	64	45	......
" 17	55	17.00	64	64	45	......
" 18	56	17.10	64	62	30	......
Total	668	184.55	......	......	......	......
Averages	......	......	62.3	62.9	47.2	3.62

RECAPITULATION.

Estimated No. lbs of milk per day	404.3
“ “ “ “ “ from which the cream was separated by hand separator	8,490.3
Total No. lbs cream for 21 days	358.85
“ “ “ butter for 21 days	125.6
“ “ “ butter for 100 lbs milk	4.22
“ “ “ milk for 1 lb butter	23.66
“ “ “ cream for 1 lb butter	3.50
Average lbs milk to 1 lb cream	6.75

The following estimates show the variations between the two separators:

	Power Separator	Hand Separator	Diff.
Avg No. lbs butter per 100 lbs milk two periods.	4.27	4.22	0.05
“ “ “ milk to 1 lb butter, two periods.	23.47	23.66	.19
“ “ “ cream to 1 lb butter, two periods	3.82	3.50	.32
“ “ “ milk to 1 lb cream, two periods.	6.12	6.75	.63

It is generally conceded that one pound of cream to six pounds of milk is about the right proportion for best work with separators. The flow of milk is regulated in the hand separator by a tube made by the manufacturers and cannot be changed, while the flow of milk in the power separator is regulated by a thumb screw and can be changed at will by the operator; but it was found that a very slight change made quite a difference in the flow, and that it required very nice adjustment to get the desired results. Although the power separator was new and had to be adjusted by careful computation of time it will be seen that the average variation between it and the hand separator in amount of butter to 100 lbs of milk was only .05 of one pound, while in the amount of milk to one pound of butter it was .19 of one pound. The difference in amount of milk to one pound of cream was .63 of one pound.

The following table shows comparative yield of milk from individual cows on the Station farm from May 15, 1892 to January 1st, 1893. The cows were all of same breed (Short-horn) and were fed the same—on grass in summer and when the pasturage began to get short a feed of grain and corn fodder was given them once per day and when the weather became cold enough to compel stabling, they had all the coarse fodder they would eat with about a peck of bran and shorts mixed in equal parts by bulk, night and morning. It is to be regretted that no more definite data of amount, and kinds of feed can be given.

for the reason that the feeding and care of the cows were conducted by another department and no notes taken. Following is comparative yield of each cow:

	May.	June.	July.	August.	September.	October.	November.	December.	Total.	Estimated yield for full year.
Number 1	517	1,101	1,073	962	791	679	489	582	6,194	9,291
" 2	330	676	731	642	567	471	354	354	4,125	6,187
" 3	127	482	427	140	9	......	582	827	2,944	4,416
" 4	388	868	830	701	549	476	375	472	4,658	6,987
" 5	436	785	871	872	705	579	456	438	5,142	7,713
" 6	399	791	817	672	503	442	285	358	4,266	6,399
" 7	379	752	782	670	531	454	346	363	4,279	6,418
" 8	221	441	434	322	254	124	......	......	1,796	2,694
Total	2,797	5,895	5,965	4,981	3,908	2,225	3,887	3,394	33,054	50,105

The right hand column of figures show approximately what the cows would yield in one full year with ordinary care or such as a farmer would naturally give them. The table gives the exact amount of milk given by each cow which was obtained by weighing each cow's milk in the stable at each milking. These cows were selected from twenty-one, all of same breed and closely allied by families, No. 1 produced 3.44 times as much as No. 8, and 1.32 times as much as No. 5 which is the next best cow in the list.

If No. 8 produced enough to pay for her keeping, No. 1 produced enough to keep 3.44 cows like No. 8, or figuring the milk of the two cows to contain 4.5 per cent. butter fat, which is nearly correct, we find No. 8 would make 151.56 lbs of butter in a full year which at 20 cents per lb would bring $30.31, while No 1 would make 518.45 lbs of butter which at 20 cents per lb would bring $103.69 or a difference of $73.38. This table and summary are intended to show the necessity of testing and weighing each cow's milk so that none but profitable cows may be kept. The cost of keeping these two cows was as nearly the same as could be determined without weighing the feed, which the Department has no facilities for doing and which was not done.

SEPARATION OF CREAM—*Gravity vs. Centrifugal.*

In September 1893 an experiment was undertaken to determine, as near as possible, the relative value of three different methods of separating cream, viz: The hand separator, the Cooley Creamer and shallow pans with conditions as nearly as possible identical with those of the average farmer. For this purpose the De Laval Baby Separator, Alpha pattern No. 2, was used. The Cooley Creamer sat out doors without ice, and the pans sat in a room used for cold storage in warm weather but without ice during the trial. The trial lasted five days in which, morning and evening, the whole milk from the whole herd was thoroughly mixed by pouring from one vessel to another, then carefully weighed and divided into three equal parts for the experiment. The following table shows the results from the hand separator:

SEPARATOR WORK.

	Prunds of milk separated.	Temperature of milk.	Revolutions per minute of separator.	Pounds of milk separated per hour.	Pounds of cream obtained.	Per cent of butter fat in whole milk.	In skimmed milk.	Amount of acid when churned—cc.	Total amount of butter in pounds.	Temperature churned.
September 26	43.50	90	7,176	330.	7.00	4.9	.1	40	......	....
September 27	38.00	84	7,176	285.	7.50	4.8	tr	40	......	....
do	35.00	90	7,026	251.	7.25	4.7	tr	40	......	....
September 28	32.00	81	7,000	270.	3.50	4.7	tr	40	......	...
do	36.00	92	7,110	266.	7.50	4.0	.1	40	9.85	62
September 29	38.00	88	7,020	285.	8.25	4.5	tr	40	......	....
do	39.33	92	7,020	226.	8.50	4.4	tr	40	......	....
September 30	35.00	96	7.020	262.	7.50	4.5	.1	40	......	....
do	35.00	92	6,820	268.	7.00	4.5	tr	40	9.50	62
Total	......	88	7,041	275.22	7.11	4.55	.033	40	......	....
Average	331.83	..	......	......	....	....	....	..	19.35	....

No. lbs of milk per lb of butter	17.14
" " " butter per 100 lbs of milk	5.83
Total No. lbs butter fat in whole milk	15.09
" " " " from one lb butter fat	1.28

COOLEY CREAMER.

	Pounds of milk set.	Temperature of milk when set.	Temperature of water when set.	Number of hours before skimming.	Per cent of butter fat in whole milk.	Cream ripened at deg. Fahr.	Per cent of fat in skim milk.	Amount of acid when churned—cc.	Pounds of butter obtained,	Temperature churned—deg.
September 26	43.50	90	54	23.	4.9	62	.2	..	......	..
September 27	38.00	84	42	23.	4.8	50	.4	.	......	..
do	35.00	90	54	23.50	4.7	62	.4	..	......	..
September 28	32.00	81	40	22.50	4.7	44	.3	..	......	..
do	36.00	92	50	24.	4.0	52	.4	40	6.00	..
September 29	38.00	88	53	23.	4.5	52	.4	..	......	..
do	39.33	92	54	23.50	4.4	56	.3	..	......	..
September 30	35.00	96	52	23.	4.5	63	.5	..	......	..
do	35.00	92	57	23.	4.5	64	.6	44	11.13	..
Total	331.83	..	......	......	....	....	....	..	17.13	..
Average	......	88	50.66	23.16	4.55	56	.38	42	......	62

Total lbs milk per lb butter	19.31
" " butter per 100 lbs milk	5.17
" " butter fat in whole milk	15.09
" " " recovered from 1 lb butter fat	35.11

SHALLOW PANS.

	Pound of milk.	Temperature of milk when set.	Number of hours before skimming.	Per cent of butter fat in whole milk.	Cream ripened at deg. Fahr.	Per cent of butter fat in skimmed milk.	Amount of acid when churned—cc	Pounds of butter obtained.	Temperature churned—deg	Temperature of room.
September 26	43.50	90	..	4.9	62	.7	..	......	....	62
September 27	38.00	84	..	4.8	50	.7	..	......	....	50
do	35.00	90	..	4.7	62	.5	..	......	....	62
September 28	32.00	81	..	4.7	54	.6	..	......	....	54
do	36.00	92	..	4.0	52	.5	50	7.50	64	52
September 29	38.00	88	..	4.5	52	.6	..	......	....	52
do	39.00	92	..	4.4	56	.6	..	......	....	56
September 30	35.00	96	..	4.5	63	.2	..	......	....	63
do	35.00	92	..	4.5	64	.4	46	11.15	61	64
Total	331.83	..	..	....	..	....	..	18.65	....	..
Average	......	88	24	4.55	56	.55	..	......	62.5	56

Total lbs milk per lb butter	17.79
" " butter per 100 lbs milk	5.55
" " " fat in whole milk	15.09
" " " recovered from 1 lb butter fat	1.23

From the three last tables it will be seen that in both the shallow pans and the Cooley process of raising cream by gravition there was considerable loss over the separator process which is shown in the following comparisons:

	Separator.	Cooley.	Pans
Amount of milk to 1 lb of butter	17.14	19.31	17.79
" " butter to 100 lbs milk	5.83	5.17	5.55
" " butter fat in whole milk	15.09	15.09	15.09
" " butter recovered from 1 lb butter fat	1.28	1.13	1.23

According to this test the loss from the milk of one cow in one year allowing that the cow would give 5,000 pounds of milk which is not a large average, may be found in the following table of comparisons. Amount of butter produced from 5,000 pounds of milk by each process as follows:

	Separator.	Cooley.	Pans
	291.13	258.93	281.05
Loss in pounds of butter		32.20	10.12
Loss at 20 cents per pound.............		$6.44	$2.02

With ten cows the loss in money in one year would be by Cooley process $64.40, and by pans $20.20; while with twenty cows it would amount to $128.80 by use of the Cooley process, and $40.40 with pans. It will be noticed that better results were obtained by milk set in pans than that submerged in water in the Cooley Creamer, which is contrary to popular belief under ordinary circumstances. The only way I can account for it is that the pans were set in the room used for a cold storage in warm weather, and which at this particular time maintained an even temperature of about 60° F. which is the most favorable temperature for cream raising by gravitation and in shallow pans. Moreover, the temperature was very constant on account of the room having been well built and very close, while in the Cooley cans the temperature was allowed to go down with the cool nights and up with the warming sun of mid-day, the only condition being that it was kept as cool as it could be by pumping cold well water into the tank morning noon and night. Just at this time when the question of hand separators is being so vigorously agitated an extended experiment might be profitable, showing the difference in yield under many varying conditions and circumstances and probably an experiment of this kind will be undertaken during the coming summer.

During the past winter many Farmer's Institutes were held in various parts of the State extending from the south line nearly to the north line in which samples of milk were brought in by the farmers and publicly tested with the Babcock milk tester. A few of these tests are given here to show the actual wide variation in the value of milk as it comes from the farm or city dairy.

Milk tested at Dell Rapids, January 5, 1894:

No.	Per Cent of Fat.	Per Cent of Butter.	Price per 100 lbs of Milk—Butter @ 20c.
1	3.00	3.75	.75
2	5.40	6.75	1.35
3	4.00	5.00	1.00

4	5.00	6.25	1.25
5	4.00	5.00	1.00
6	4.40	5.50	1.10
7	5.00	6.25	1.25
8	7.20	9.00	1.80
9	4.20	5.25	1.05
Average	4.69	5.86	1.17

Milk tests made at Lake Preston, January 4, 1894:

No.	Per Cent of Fat.	Per Cent of Butter.	Price per 100 lbs of Milk—Butter @ 20c.
1	3.00	3.75	.75
2	3.60	4.50	.90
3	6.60	8.25	1.65
4	5.40	6.72	1.35
5	3.60	4.50	.90
6	3.60	4.50	.90
7	3.60	4.50	.90
8	7.20	9.00	1.80
9	3.80	4.75	.95
10	3.40	4.25	.85
11	4.20	5.25	1.05
12	3.40	4.25	.85
13	8.00	10.00	2.00
14	8.20	10.25	2.05
15	4.60	5.75	1.15
16	4.40	5.50	1.10
17	4.40	5.50	1.10
18	5.60	7.00	1.40
19	6.60	8.25	1.65
20	5.60	7.00	1.40
21	6.40	8.00	1.60
22	5.40	6.75	1.35
23	7.00	8.75	1.50
24	7.00	8.75	1.50
25	3.00	3.75	.75
Average	5.11	6.38	1.26

In this table it will be seen that $1.26 is the average price for the milk tested, computing butter at 20 cents per pound, while 75 cents is the lowest and $1.80 the highest price. The difference between the maximum and the minimum price is $1.05. In other words if this milk was to be pooled in a co-operative factory and all patrons to be paid same price per 100 pounds of milk No. 25 would get the difference between 75 cents and the average price $1.26 more than belonged to him, which would be 51 cents per 100 pounds, while No. 8 would get the difference between $1.80 and the average price $1.26 less than belonged to him, which would be 54 cents.

These tests were very carefully made and are given here to show the fallacy and injustice of the old practice of paying for milk or cream by volume or weight. A careful study of these tables will prove both suggestive and instructive to those who contemplate patronizing a co-operative cheese or butter factory.

Milk tests made at Bryant, January 23, 1894:

No.	Per Cent of Fat.	Per Cent of Butter.	Price per 100 lbs of Milk—Butter @ 20c.
1	6.00	7.50	1.50
2	6.40	8.00	1.60
3	5.00	6.25	1.25
4	4.60	5.75	1.15
5	5.80	7.25	1.45
6	8.20	10.25	2.05
7	6.80	8.50	1.70
8	5.20	6.50	1.30
Average	6.00	7.50	1.50

Milk tests made at St. Lawrence, January 31, 1894:

No.	Per Cent of Fat.	Per Cent of Butter.	Price per 100 lbs of Milk—Butter @ 20c.
1	4.20	5.25	1.05
2	6.80	8.50	1.70
3	5.60	7.00	1.40
4	6.20	5.25	1.05
5	4.80	6.00	1.20
6	5.20	6.50	1.30
7	6.60	8.25	1.65
8	4.80	6.00	1.20
9	5.60	7.00	1.40
10	4.20	5.25	1.05
11	5.20	6.50	1.30
12	9.00	11.25	2.25
13	5.60	7.00	1.40
14	4.00	5.00	1.00
15	3.60	4.50	.90
16	4.40	5.50	1.10
17	5.60	7.00	1.40
18	4.20	5.25	1.05
19	4.40	5.50	1.10

20	4.80	6.00	1.20
21	4.60	5.75	1.15
22	3.60	4.50	.90
23	7.80	9.75	1.95
24	6.80	8.50	1.70
25	4.60	5.75	1.15
26	9.20	11.50	2.30
Average	5.40	6.75	1.35

Milk tests made from skimmed milk:

No.	Per Cent of Fat.	Per Cent of Butter.	Price per 100 lbs of Milk--Butter @ 20c.
1	1.00	1.25	.35
2	.10	.02	.04
3	.60	.75	.15
4	1.60	2.00	.40
Average	.85	1.06	.21

Buttermilk:

No.	Per Cent of Fat.	Butter in 100 lbs.	Price per 100 lbs of Milk—Butter @ 20c.
1	.80	1.00	.20
2	1.20	1.50	.30
3	1.50	1.87	.37
Average	1.16	1.45	.29

But few samples of skimmed or butter milk were brought in, but enough to show that considerable waste is incurred in the common practice of setting milk for cream, and in the ripening and churning the same into butter. More attention will be given this part of the work in future with the hope of being able to check this waste, and save it to the farmer who keeps a few cows.

Following are the results obtained from the College herd of cows from January 1st, 1893 to January 1st, 1894. The milk was weighed from each cow at each milking and an accurate account kept of same for the entire period.

The Ayrshires, Devens, Guernseys and Jerseys were purchased in Wisconsin in March and could not be expected to do as well as cows that had become acclimated and used to Dakota grown feeds.

The whole herd have been kept on prairie grass for pasturage, but were fed some fodder corn when grass began to get short from drouth. While on grass they were not fed grain except, perhaps, a pint each of bran and shorts night and morning as an inducement for them to take their places in the stable to be milked.

In winter they were fed on fodder corn and millet for hay, and when we had it, ten pounds of bran and shorts to each cow per day, and when the days were warm enough not to freeze, they were allowed to run in the yard and to ricks of fresh straw. But when the weather would not permit of outdoor exercise they were fed straw at noon in the stable, which seemed to be highly relished by them. The stables are in a basement where the temperature is easily kept above freezing. No hay was fed them during the winter. These cows have not been crowded in any way, the object being to keep them as nearly as possible as a good, prudent dairy farmer should keep cows in Dakota, and the figures given in the table below are not intended to show the best possible results obtainable, but to show the practical results of keeping a herd of good dairy cows as any ordinary farmer can keep them if he will. The writer believes that he is thoroughly acquainted with the conditions surrounding the average farmer in this state and believes it to be the duty of this department to try those experiments first, which may be of the most practical benefit to him, and most easily reached by him, with the means he may have at his command, with as little extra outlay as possible:

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total pounds milk.	Average per cent. butter fat.	Pounds of butter in year.	Value of butter @ 20 cts. per lb.
Proserpine,* Holstein Friesian, calved Feb. '92.	757.09	663.	738.13	645.03	669.04	733.02	550.01	234.04	6.09	......	......	881.06	5,899.11	3.35	246.58	49.32
Lakeman Lass, Holst. Fries., calved Dec. 20, '92..	929.04	960.	949.08	914.16	890.	929.18	877.08	701 01	492.	289.10	155.05	244.04	8,032 14	3.29	330.12	66.02
Lakeman Lassie, Holst. Fries., calved Feb. 12, '93	243.02	209.	228.04	179.16	108.04	376.08	597.14	570.02	482.06	438.08	380.17	378.01	4,222.02	3.68	194.21	38.84
Elmside Lass, Holstein Fries., calved June 8, '93	......	304.04	628.08	541.12	493.06	523.	496.11	404.02	293.04	265.18	297.	228.04	4,475.09	4.18	233.69	46.73
America 1, Short Horn, calved May 5, '93........	539.11	273.11	45.11	......	834.08	1266.18	1220.12	1020.16	773.12	718.05	713.14	659.09	8,066 09	4.00	403.30	80.66
America 2, Short Horn, calved April 8, '93......	302.	189.05	45.08	531.09	791.12	765.14	676.04	584.08	463.13	400.01	350.	318.	5,325.14	4.00	266.25	53.25
Maggie Hughes. Short Horn, calved April 28, '93	354.	201.03	57.09	44.13	891.12	1013.08	965.10	754.19	520.	428.13	446.	392.05	5,840.	5.50	401.20	80.24
Mary Clay, Short Horn, calved June 8, '93........	455.	386.	387.19	229.	79.11	....	710.	959.09	655.09	640.09	644.02	624.07	5,774 06	4.52	325.23	65.05
Rose of Bloom, Short Horn, calved Nov., '92....	789.	624.09	741.04	582.12	553.06	743.06	727.16	447.03	149.08	......	......	......	5,361.40	3.75	240.91	48.18
Lady Holbrook, grade, calved March 10, '93.....	......	......	336.17	541.18	564.03	585.15	572.03	420.17	330.	198.02	178.09	54.08	3,782.12	4.56	215.58	43.12
Hebron, Devonshire, calved March 5, '93	......	......	......	518.07	710.12	754.07	713.05	504.07	619.07	312.01	266.05	170.04	4,570,15	5.65	322.65	64.53
Birdie, Devonshire, calved July 5, '93............	......	......	......	......	......	....	734.	859.11	659.05	619.09	608.03	559.07	4,040 15	4.60	232.20	66.46
Queen, Ayrshire, calved Sept. 4, '93.............	......	......	185.03	300.15	314.16	319.14	233.02	42.14	544.04	615.10	469.07	451.01	3,476.06	4.36	189.09	37.82
Lille, Ayrshire, calved May 12, '93..............	......	......	......	......	321.	1151.08	1060.14	829.06	533.18	442.16	374.11	521.09	5,268.	4.93	324.50	64.90
Daffodil, Guernsey, calved July 14, '93..........	......	......	220.11	356.05	335.08	264.08	236.14	....	31.16	......	.....	49.02	1 494.04	4.30	80.23	16.04
Lauretta, Guernsey, calved March 14, '93........	......	......	443.06	775.07	787.15	866.02	863.16	682.18	351.06	416.08	463.11	478.04	6,129.00	5.00	383.06	76.61
Square's Beauty,† Guernsey......................	......	......	......	......	......	......	......	....	......	......	.....	......	....	....	......	.....
Serrepta, Guernsey, calved Sept. 11, '93.........	......	......	......	......	......	......	......	....	145.14	807.10	738.16	689.08	2.582 08	4.60	137.02	27.40
Barca, Guernsey, calved March 11, '93...........	......	......	183.10	374.13	386.18	445.12	450.02	337.03	305.06	221.09	174.07	211.	3,090.	5.24	202.39	40.48
Mary Grant, Jersey, calved June 2, '93...........	......	......	266.10	284.04	328.13	431.17	416.06	379.08	256.05	365.01	264.03	251.08	3.243.15	5.78	230.91	46.18
Lady P. Pogis, Jersey, calved Nov., '92..........	......	......	340.01	449.07	626.	666.15	720.07	480.13	268.09	242.06	228.05	232.05	4,254.02	5.28	257.79	31.56
Lady Mahopac, Jersey, calved Aug. 10, '93......	......	......	367.19	442.09	438.11	503.01	420.07	239.08	369.07	367.	387.04	388.08	3,623.14	6.16	293.47	58 69
Ella Europa, Jersey, calved Oct. 29, '93..........	......	......	295.02	514.10	542 19	579.	550.13	377.06	78.01	......	340.01	460.08	3,738.	6.20	289.69	57.94
Enamel, Jersey, calved March 20, '93............	......	......	68.13	700.09	663.05	669.10	647.	471.12	387.02	284.06	308.05	203.06	4,403.08	4.92	270.78	54.16

* Fresh Dec. 6, '93. † Farrow.

HOLSTEIN FRIESIANS.

Broserpine had been giving milk 13 months before this record was commenced.

Lakeman Lass is an imported cow, 10 years old April 3d.

Lakeman Lassie is the daughter of Lakeman Lass and was four years old March 29th.

Elmside Lass is a daughter of Lakeman Lass was three years old December 25th, 1893.

SHORT-HORNS.

America 1st is a roan cow, 6 years old July 5, 1893.

America 2nd is a red cow 5 years old December, 1893.

Maggie Hughes is red and five years old June 4, 1893.

Mary Clay is red and was 9 years old April 7, 1893.

Rose of Bloomfield is red and was four years old April, 1893.

Lady Holbrook is a grade Holstein 4 years old April, 1893.

DEVONS.

Hebron is dark red, 5 years old April 19, 1893.

Birdie is dark red, 5 years old April 30th, 1893.

AYRSHIRES.

Queen is red and white, spotted, 8 years old, September 4th, 1893.

Lilly is red and white, spotted, 7 years old, April 13, 1893.

GUERNSEYS.

Daffodil was 11 years old August 22d, 1893. She injured her udder and gave garget milk for a long time during which her milk was not recorded.

Lauretta is a very fine type of Guernsey six years old, March 19, 1893.

Square's Beauty did not come in; she was 3 years old February 26, 1893.

Serrepta was 3 years old February 12th, 1893.

Barco was two years old February 4, 1892; was due to calve May 1st but got hurt in shipping and lost her calf March

11th. She was brought to her milk, however and did very well.

JERSEYS.

Mary Grant is a fawn color and five years old Feb. 18, 1893.

Lady Pansey Pogis is fawn color and 6 years old August 2d, 1893.

Ella Europa, 3d, is dark bronze and white and was 5 years old February 19th, 1893.

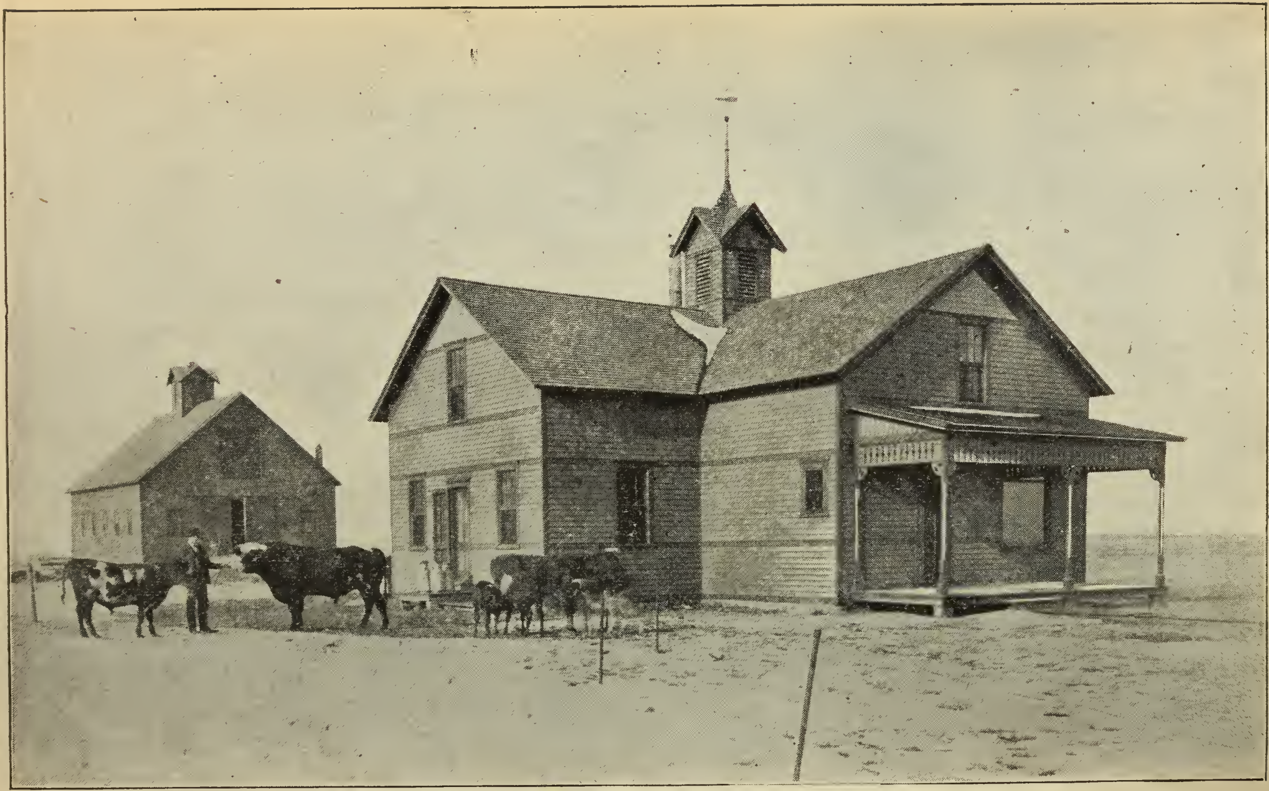
Lady Mahopac is fawn and white and 5 years old January 17, 1893.

Enamel is light fawn color 2 years old April 25th, 1893, and is a beauty, giving promise of a very fine cow.

These short sketches are given to enable those interested in the record table to judge better of the merits of the different breeds, age having something to do with the richness of milk. The older a cow is up to and including her prime, the richer her milk.

The limitation for space in this bulletin will not permit of more explicit data being given than is contained herein but all further information desired will be cheerfully furnished by the department.

Oct. 17, 1894



View of Dairy Building and Barn.

Nov, 19 1894

SOUTH DAKOTA
AGRICULTURAL COLLEGE
AND
EXPERIMENT STATION

BROOKINGS, S. D.

BULLETIN NO. 40.

MAY 1894.

Departments of Chemistry and Botany.

Native and Introduced Forage Plants.

DUTCHER, BREED & STORGAARD, BROOKINGS.

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Harvey N. Ott,	Animal Pathology

Ed. F. Hewit,	Secretary and Accountant

ASSISTANTS.

J. M. Parkinson,	Librarian
Cyril G. Hopkins,	Assistant Chemist
Hubert B. Mathews,	Meteorologist
Edmund T. Bates,	Assistant Dairyman
A. W. Williams,	Farm Foreman

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NATIVE AND INTRODUCED FORAGE PLANTS OF SOUTH DAKOTA.

DEPARTMENTS OF CHEMISTRY AND BOTANY.

INTRODUCTION.

NATIVE GRASSES.

The true grasses are one of the most valuable families of plants. To them belong the small grains (oats, wheat, barley, etc.,), corn, the various sorts of cane, the great bamboo of Asia, and a host of other plants of more or less importance to man or beast. In the great prairie regions of the United States the grasses form by far the greater part of the natural vegetation and constitute one of the most valuable of the natural resources as well.

In our own state of South Dakota stock-raising has been one of the leading industries ever since its settlement, and will continue to be so for years to come. The state, as a whole, is peculiarly well adapted to stock-raising and dairying. One of the most important elements in this fitness is the great richness of the grass flora and of the native species in particular.

About one hundred and sixty species of grasses are known to grow within the limits of the state. Of these, about one hundred and five are native to the soil, the remainder being found either under cultivation or introduced some other way. Some of them are weeds, but the majority are more or less useful as forage plants.

The introduced species are much more common in the eastern and southern parts of the state, that is, in the older settled portions. Of the native species, probably sixty per cent are found quite generally distributed throughout the state. Many of these, however, though occurring in nearly all parts of the state can only be said to be plentiful over a limited area. For example, the bushy blue stem grows in all parts of the state, but occurs in large quantities only in the Sioux Valley and in a few other localities less extended, principally along the lower Missouri. Some grasses are quite local in their distribution, usually owing to certain soil or climatic conditions, or to certain physical features of the country. Though so many different kinds of grasses help to make up the grass flora of the state, the greater part of the forage obtained is furnished by a much less number. Fully seventy per cent of the hay from grasses native to the soil is obtained from less than a dozen species. The same is true of the native pasturage. Probably ninety-five per cent of the native forage comes from less than twenty different kinds of grasses. In any one locality the number of kinds rarely exceeds a half dozen.

The state may be divided roughly into five regions, more or less well defined by the grass flora peculiar to each. (1) The Sioux Valley Region includes the most of the eastern and southern parts of the state. West of this lies the James River Valley extending through the entire state north and south. The lower part of this valley—near where it joins the Missouri—possesses a grass flora much like that of the Sioux valley, and may be considered as belonging more properly to that region. The greater part of it, however, is quite different in the main, so that we have (2) a James River Valley Region with a flora which is quite characteristic. West of this comes (3) the Missouri Valley proper with a great variety of grasses. Joining the Missouri Valley Region on the west is (4) the great Range Region of the state with a grass flora quite different from that of any other region. In the southwestern part of the state is found (5) the Black Hills Region, with a peculiar combination of mountain, woodland, and prairie forage plants.

THE SIOUX VALLEY REGION.—Probably the most characteristic grasses of the Sioux Valley region are the blue stems, particularly big blue stem and bushy blue stem. These grasses though occurring all over the state, are seldom found in great quantities outside of this region. There are, however, a few localities in the James River Valley and in the upper Missouri

Valley where they flourish. The blue stems thrive best in rich moist soil. They become more plentiful as civilization advances. As the buffalo and grama grasses disappear through excessive grazing and the changes incident to a more thorough cultivation of a part of the country, the blue stems take their places.

In eastern Nebraska, ten or fifteen years ago the blue stems could only be found in the bottom lands and "draws" while today they are plentiful everywhere on the high, dry soil of the hills as well as in the valleys. This same thing is happening in our own state. These grasses should be encouraged by every possible means.

Besides the blue stems there are several other grasses of great value common in this region. Switch grass is next in importance to the blue stems. In some of its many forms it is found more or less plentifully on both dry and moist soils. It constitutes a considerable part of the forage obtained from the lowland meadows. Other grasses somewhat common in this region are reed canary grass, blue joint, fowl meadow grass, the grama grasses, cord grass, the wheat grasses, and others of less importance. About 90 per cent of the native hay and 80 per cent of the pasturage is obtained from the first three grasses mentioned—big blue stem, bushy blue stem, and switch grass.

THE JAMES RIVER VALLEY REGION.—Though most of the grasses of this region occur also in the Sioux Valley, yet the general features of the grass flora are considerably different. The blue stems occur in this region but are seldom found in large quantities. Instead of furnishing most of the hay they furnish but a relatively small part of it. Switch grass is plentiful; and this grass, together with blue joint, sand grass, and the wheat grasses furnish by far the greater part of the hay, while these grasses and the grama grasses furnish most of the pasturage.

The wheat grasses, particularly western wheat grass (*Agropyrum glawcum occidentale*), are the most important "all round" grasses of this region. Western wheat grass furnishes about 90 per cent of the native hay as well as most of the pasturage. Land that has been allowed to "go back" soon comes up to this grass and two and three tons to the acre have been cut from such fields. Blue joint and the sand grasses are also very common and are characteristic of the region. In dry, sterile, saline soils, salt grass occurs very plentifully. Porcupine grass and needle grass (*Stipa comata*) also occur and do considerable damage to sheep (particularly lambs) though they yield a considerable amount of early feed, and, if cut after the needles have fallen, are valuable for hay.

THE MISSOURI VALLEY REGION.—The grass flora of this region is peculiar because of its varied character. Along the lower part of the valley the blue stems are not uncommon, but they seldom occur in any considerable quantities in the upper part of the valley. Little blue stem is the commonest of these grasses, but is of little value for hay. Blue joint, sand grass, and cord grass are abundant along the sandy bottoms. Wheat grass and switch grass are also plentiful. On the dry uplands, back away from the river, grama, needle grass, wheat grass and buffalo grass abound. In many places needle grass is the principal hay grass. False buffalo grass is plentiful along the sandy river bottoms and often occurs in the bare places about ant hills, but it is of little value as forage.

THE RANGE REGION.—The number of species occurring here is much more limited than in any of the other regions. The greater part of the hay is cut from western wheat grass. In years of excessive drouth this grass seldom goes to seed, but lives over fall and winter by means of its underground stems or rootstocks. It is often so dry when cut that it can be raked and stacked immediately. This is so rich in nutrient substances that stock do well when fed upon it, even with little or no grain. Fully ninety-five per cent of the pasturage is obtained from wheat grass, blue grama and buffalo grass.

Among other grasses occurring in this region are cordgrass, slender cordgrass, little blue stem, needle grass, sand grass and salt grass.

THE BLACK HILLS REGION.—The grass flora of this region is rich in the number of its species. In the drier foot hills are found the grasses that have been mentioned as characteristic of the range region with a mixture of forms growing naturally on more moist soils. In the Hills proper, many other species thrive because of the greater amount of moisture in the soil. In many of the moister valleys along the edge of the Hills the blue stems occur in greater or less abundance. Switch grass is plentiful. Western wheat grass is abundant in the foot hills.

SOME GENERAL CONSIDERATIONS.—A study of the meteorological records of the state shows that the climatic conditions are not alike in any of these regions.

The average temperature for the Sioux Valley, especially the upper part, is rather lower than that of any other region. That of the James Valley is higher. The averages of the Missouri Valley and the Black Hills are nearly the same—the latter being perhaps a little the milder; but either is warmer than the James Valley or the Sioux Valley.

The average annual precipitation is greatest in the Black Hills. There is but little difference between the average annual precipitation of the Sioux Valley and that of the James Valley in South Dakota. The Missouri Valley has less than either the Sioux or James Valley. The range region gets the least amount of rainfall. On the whole, however, these variations in temperature and rainfall are not great enough to account for all the differences between the floras of the various regions. There are certain soil conditions in each that exert a considerable influence upon the character of its flora. Then again, the lay of the land in each region may have a great effect upon the plants—especially upon their distribution.

The grass flora of the Sioux valley has been modified materially by cultivation of the soil, by pasturing and by a better control of prairie fires. The change has been greatest in this region partly because of certain modifications in the climatic and soil conditions, partly because of its being longest and generally most thickly settled, and partly because it is closely connected with the excellent blue stem region of Iowa, Nebraska and Minnesota.

It is evident that the differences between the native grass floras of the various regions, and the causes of these differences will have considerable bearing upon the question of the growing of introduced forage plants. It will not be surprising to find that a forage plant that fails in one region will succeed in another or vice versa. With the irrigation possible in the James Valley many grasses can be grown that would not succeed in other parts of the state where no irrigation is possible. On the other hand, the soil of the Sioux Valley, because of the fact that it has been generally longer under cultivation, and because of different climatic or other conditions will, for some time at least, be better adapted to those forage plants that thrive best on the older cultivated soils. The fact that the blue stems are becoming so plentiful shows that conditions are becoming more and more favorable for such cultivated forage plants as timothy, clover, redtop and the like.

Careful conservation of surplus water from snows and rain by the building of dams at close intervals across runs and creeks and tree planting will increase the possibilities of raising the better class of forage plants.

One need not be discouraged then to find that a forage plant that has done well in one region fails in another. Careful study of the best native grasses will show what characters enable them to thrive when their weaker neighbors succumb in the struggle for existence. Then by selecting forage plants that have these characters best developed, much useless labor and waste of money may be avoided.

Land is plentiful in all parts of the state, and every farmer could, with profit, devote a small plot of one or two acres to experiments with the various forage plants of promise. It is better to work with only a few of the best kinds at a time. One can then be able to give them proper care and the results obtained will be of much more value. A single season is not long enough to decide properly, the value of any plant, especially those with perennial roots. Give a forage plant a fair trial for a series of seasons before discarding it entirely.

INTRODUCED OR CULTIVATED GRASSES.

The introduced grasses may be divided into two classes—those brought in for cultivation and those introduced accidentally, the seeds having been mixed with other grasses or grains, or by the many ways that nature has provided for the distribution of the various kinds of seeds. To the first class belong timothy, smooth brome grass, millet, the more important fescues, perennial or Italian rye grass, red top, orchard grass, and many others. All are more or less useful, though they cannot at present all be grown successfully in this state. To the second class belong grasses of much less importance as forage plants; but on the other hand many of them are pernicious weeds. Grasses of this class are represented by the foxtails, stink grass, chess and some of the panic grasses. They usually do more harm as weeds than good as forage plants, and when such is the case they should be exterminated in every possible way.

For the last five years experiments have been in progress on the grounds of the Experiment Station testing the hardiness and relative values of the various grasses in common cultivation and of a number of native species that seemed worthy of cultivation.

The most satisfactory grass tried thus far is the smooth brome grass (*Bromus inermis*) or as it is sometimes called, Hungarian brome grass. It catches readily and gives a good stand when sown either in drills or broadcast. It soon forms a good sod and makes a good growth the first year. It is one of the first grasses to appear in spring. It sprouts up immediately after cutting, giving an abundance of fall pasturage, and is not killed easily by the autumn frosts. Thus far it has endured almost perfectly both the drouth of summer and the dryness and severe freezings of winter. Timothy has done well on rich and rather moist soil, particularly when mixed with alsike or other clovers. It does well under irrigation. It will not thrive at present in the drier parts of the state and should never be used alone as a pasture grass. It will not stand close grazing in our climate and on our soil. To get the best results a timothy meadow should be treated at least every other year with a light coat of well rotted stable manure and then in early spring given a light harrowing.

Red fescue, sheep-fescue and hard fescue are all hardy enough to stand the climate in the eastern part of the state and probably also that of most localities east of the Missouri river or in the Black Hills. They furnish an abundance of pasturage but are of no value for hay. They are particularly valuable on sheep ranches.

Tall fescue and meadow fescue give paying crops of hay on moist meadows. Of the two varieties meadow fescue is to be preferred. Both give best returns when mixed with other grasses such as red-top, orchard grass and smooth brome.

Kentucky blue grass or June grass as it is often called, is hardy in the Sioux Valley and will probably do well in many other parts of the state. Creeping spear grass or June grass, a near relative of Kentucky blue grass has also given good results. A number of instances have occurred where these grasses sowed directly upon the prairie sod have taken hold and gradually spread over much larger areas. Kentucky blue grass is the better grass of the two as it is a good hay grass as well as a good pasture grass while the other is fit only for pasture. The creeping spear grass is, if anything, hardier than the other, standing drought rather better. Neither should be cut or grazed too closely during July and August but should be allowed to produce enough leaves to shade the ground, thus protecting the roots, and root stocks from the hot sun.

No good trial has been made with orchard grass. In one experiment the grass did well on low moist soil. In some later experiments made on high dry soil seed purchased for orchard grass turned out to be perennial rye grass, a species of little value in this State. Orchard grass is a good grass, however, and generally hardy, so it is worthy of trial where one is trying to establish a good meadow.

The following grasses have proved of little or no value for this region: Johnson grass, sweet vernal, perennial rye grass, Rescue grass (also called Schrader's brome grass), and hair grass. The latter is fairly hardy but does not afford sufficient forage to pay for its cultivation.

The native grasses that have shown themselves worthy of cultivation are: Western wheat grass, slender wheat grass, blue joint, and reed canary grass. All have, thus far, been perfectly hardy and the yield of hay has been much larger than usually obtained from wild meadows.

Several attempts to get a good stand of switch grass have failed. One small patch, however, has done well enough to show that much is to be expected from this grass. Up to the present time the blue stems have not done well from the seed but plats of sod taken from the prairies give something of promise. Further attempts will be made with these and with switch grass also.

Oregon blue grass though rather slow in catching and in forming a good sod has given excellent results when once well established.

Muhlenberg's grass has also given hopeful results.

CLOVERS.

It has generally been thought impossible to grow clovers in South Dakota, except perhaps in the extreme southeastern corner of the State. The hot sun and dry weather of July and August and the dryness and cold of the average winter have been thought to be too severe for these plants.

It is probably true that for the drier portion of the State there is little hope of the successful growing of many of the clovers for some years to come. The results of the experiments on the Station grounds, however, show that there are certain of the clovers and clover like plants that can be grown, and with a considerable amount of success too, in localities where the soil and climatic conditions are similar to those obtaining at Brookings and in the Sioux Valley, generally.

Alsike and White clover have given excellent results, particularly when mixed with some of the grasses such as timothy, meadow fescue, and the blue grasses. Up to the present time Alsike has been the most satisfactory clover tried.

Scarlet clover and mammoth clover are too tender for our region.

Red clover has sometimes succeeded but has also frequently failed. It does better in the older portions of the state. In many parts of the Sioux Valley some good clover and timothy fields are growing at the present time. All clovers do best when mixed with timothy or some other of the grasses.

The Melilots, both the yellow and the white, have shown themselves able to make a good growth under the most adverse circumstances. As they are biennials, but two crops can be cut from one sowing. The forage obtained, while not first class, is much better than nothing and the yield is usually large. They should be cut before the stem becomes woody. They are good plants for soiling purposes and may be used to advantage when one is desirous of cleaning out or resting up a field.

Alfalfa has proven hardy and makes a good growth but has suffered so severely from a disease due to a fungus that it has not been a success. Future experiments will be made to ascertain whether this trouble may not be overcome.

Other plants of the clover family have given promise of more or less value as forage plants, but need more study before an intelligent report can be made upon them. The most important of these are goat's rue, sand clover, esparsette, and Hedysarum.

MISCELLANEOUS FORAGE PLANTS.

Besides the true grasses and the clovers mentioned in the preceding pages, there are a large number of other plants that are eaten by stock either as green or dry forage. Much of the early grazing along lake margins, streams, and in sloughs consists of sedges and rushes. Hay cut in such places is often also composed largely of these plants.

Along the Missouri river and throughout the region extending to the James river, stock feed a great deal upon a plant known among stockmen as *wild vetch.* It belongs to the clover family and occurs, more or less plentifully, throughout the prairie regions of the west. It is considered of great value by the stockmen. It is the *Hosackia purshiana* of the botanies and is closely related to the true vetches.

Knot-weed, or goose-grass is a common door yard or way side weed that is much sought after by stock, particularly by cattle.

EXPLANATION OF TERMS USED IN DESCRIBING FORAGE PLANTS.

Acute.—Sharp pointed.

Achenes.—Small, dry, hard, one-seeded fruits, as in some of the sedges.

Annual.—Living but one season.

Anther.—The organ containing the pollen or "dust" of the flower.

Apex.—The top or extreme end of a leaf or any other part of the plant.

Appressed,—Pressed together.

Ascending.—Rising obliquely from the ground.

Awl-shaped.—Narrowed gradually to a fine point, like an awl.

Awn.—A bristle-like projection from a glume or "chaff" often called a "beard."

Biennial.—Living through two seosons.

Blade.—The expanded portion of a leaf.

Bristles.—Short, stiff hairs.

Bulbous.—Thickened like a bulb.

Chaff.—The dried glumes and palets that cover the seeds of grasses.

Ciliate.—Having the edges fringed with hairs.

Compressed.—Flattened laterally.

Cuspidate.—Ending in a sharp tooth-like point.

Decumbent.—Lying on the ground, but with the top raised.

Entire.—Without notches or divisions.

Fertile.—Producing fruit.

Fibrous.—With thread like branches or divisions.

Glabrous.—Smooth, without hairs or roughness.

Glaucous.—Whitish on the surface, giving the parts a grayish or bluish green appearance.

Glumes—The "chaff;" the two lowermost glumes of a spikelet are called the *empty glumes*, while the single glume just at the base of each flower is the *flowering glume.*

Inflorescence.—The arrangement of the flowers.

Herbaceous.—Herb-like, not woody.

Hirsute.—With rather stiff and coarse hairs.

Imbricate.—Closely overlapping each other, like the shingles of a roof.

Indigenous.—Native to the soil, not introduced.

Involute.—Rolled inward.

Joints.—Thickenings in the stem from which the leaves arise.

Keel.—A glume has a keel or is said to be *keeled* when its back is sharp or ridged like the keel of a boat.

Lanceolate.—Tapering gradually to a point.

Linear.—Long and narrow, with parallel sides.

Midrib.—The central and principal nerve of a leaf or glume.

Nerves.—The ribs or veins of a leaf, glume or other leaf-like organ.

Oblong.—Longer than wide, with nearly parallel sides.

Obovate.—Egg-shaped with the wider end uppermost.

Obtuse.—Blunt or rounded at the apex.

Ovary.—That part of the pistil containing the seed.

Ovate.—Egg-shaped.

Palet.—The inner chaff or scale of a flower, standing opposite to the flowering glume.

Panicle.—A spreading, bushy head as in oats.

Perennial.—Living more than two years.

Perigynium.—The sac-like body surrounding the ovary in certain sedges.

Petiole.—The stem of a leaf.

Pistil.—The central or female organ of a fertile flower.

Pistillate.—Having pistils but no stamens.

Pollen.—The powder contained in the anthers.

Ribs.—Prominent nerves of the leaves or like organs.

Root Stock.—An underground stem running horizontally.

Serrate.—Having teeth on the margin which are pointed toward the apex.

Sessile.—Without a foot-stalk or pedicel.

Sheath.—That part of the leaf which surrounds the stem of the plant.

Spike.—Such an arrangement of the flowers as that in wheat or rye.

Spikelet.—A cluster of flowers having a pair of outer glumes.

Stamen.—The male organ of a flower.

Staminate.—Having stamens but no pistils.

Sterile.—Imperfect flowers not producing seed.

Stoloniferous.—Sending out off-shoots or runners from the base.

Succulent.—Fleshy and juicy.

Tufted.—Growing in bunches.

Woolly.—Clothed with long, matted hairs.

THOMAS A. WILLIAMS, Botanist.

SOME CHEMICAL CONSIDERATIONS.

The collection and analyses of the native and introduced forage plants of South Dakota has extended over several years. The work was begun in 1889 and was completed in 1893. The plants were carefully selected by hand so that each sample should contain but one species. They were gathered just when they were in bloom and best adapted for use as fodders. Moreover, in the case of the native grasses each sample was selected from a locality in which it was growing well and in which it appeared to be permanent.

As soon as a sample was gathered it was tied loosely and allowed to dry in the open air. All samples were brought to the requisite state of dryness suitable for grinding by exposure to the steam heated atmosphere of one of the laboratory rooms devoted to the preparation of samples. It will be readily understood, consequently, that hay made from any of these plants and cured in the open air would contain rather more moisture than that given for the air dry substance. As soon as a sample was ground it was placed in a tightly stoppered bottle until required for analysis. The grinding was effected by an ordinary Enterprise drug mill and was continued until the whole sample passed through a one millimeter mesh seive.

Some of the reasons which induced this Station to undertake the tedious and expensive investigation of these forage plants ought to be enumerated. In the first place common report among stock men declare that our forage plants are exceptionally nutritious. Moreover, the well known belief that northern grown grasses and grains are richer in nutrients than their bulkier relatives grown farther south, seemed to indicate the necessity of determining in just what respect, if in any, this increase in nutritive value consisted.

Again, should our forage plants be found to possess nutritive ratios differing from those previously determined the facts would be found useful in a rational and scientific system of stock feeding. And finally, some of the native plants have not been exhaustively investigated while many of them have not been analyzed at all or their analyses are not accessible to the general reader.

A comparison of the analyses here given with those in Experiment Station Bulletin 11, U. S. Department of Agriculture, will show that the crude fibre in South Dakota grown forage plants averages high. This fact taken together with the climatic conditions of much sunshine and dry weather during the fall months, will explain why in the range regions our grasses cure standing on the prairie and afford such valuable winter grazing. Moreover, the plants ripen before the frosts come. Indeed when snow does not interfere, and such interference is the exception rather than the rule, stock does well on the uncut grasses remaining on the prairies. It is no uncommon occurrence to find farmers mowing every month in the year. And in some cases two years' growth of grass is harvested at one mowing. While these practices are not to be recommended nevertheless they have been found useful in times of emergency. Hay should be cut and cured at the proper time to avoid deterioration.

By further comparison with the same tables it will appear that the crude protein runs high which materially narrows the nutritive ratio thus affording a more nearly balanced ration. This would explain the remarkable thrift of grass fed stock in the range regions. Other variations become apparent upon investigation.

EXPLANATION OF TERMS USED IN ANALYSIS.

Water.—Although hay may be apparently dry to the touch, nevertheless it always contains more or less moisture when dried in the air. Moreover, it is very hygroscopic and the amount of moisture it contains at any one time will depend upon the state of the atmosphere and how it is stored. The water given in the analyses was obtained by drying the sample at the temperature of boiling water in a current of hydrogen.

Ash.—The ash is obtained by burning the fodder in open crucibles at the lowest possible temperature. The ash constituents of plants are valuable to the animal economy since they form an important part of many of the tissues and especially of the bones. Since the ash constituents are usually plentiful but little attention is paid to them in compounding rations.

ETHER EXTRACT.—The ether extract consists mainly of fats and oils and many writers refer to it simply as "fat." But it contains other bodies such as gums and coloring matter and for the sake of accuracy the longer term is used here. It is obtained by treating the fodder with ether. These substances are heat and force producers and give origin to the deposits of fat in various parts of the animal.

CRUDE FIBRE.—The crude fibre is the woody portion of plants found in the cell walls. It is determined by dissolving out all other parts of the plant by means of dilute acids and alkalies. When digested, the crude fibre performs the same offices as the ether extract.

NITROGEN-FREE EXTRACT.—This extract consists mainly of sugars, starch, dextrin and gums. It is obtained by difference. The sum of all the other constituents is substracted from 100. The name is not a very good one since it is not distinctive. This extract performs the same offices as the crude fibre in the animal economy.

The last two terms comprise substances which are composed of carbon, hydrogen and oxygen only. So they are often called by one comprehensive name, Carbo-hydrates. The crude fibre and the nitrogen-free extract are of about equal values for feeding purposes; but the ether extract is worth about 2.5 times as much as either the crude fibre or the nitrogen-free extract.

CRUDE PROTEIN.—Under this head is grouped a class of substances which contain in addition to carbon, hydrogen and oxygen, nitrogen also. The crude protein builds up the lean meat, the ligaments and connective tissues of animals. It also supplies the blood with albumen and the milk with casein. It is also an important constituent of the hair, skin, and other parts of the animal. When the supply of carbohydrates is scant, the crude protein may also supply heat for which purpose it is about equal to the carbohydrates. It is worth still less as a fat producer. But it is not economical to compel an animal to convert crude protein into fat or to use it to supply heat and energy. Crude protein is more expensive than the fats and carbohydrates and does not do their work so satisfactorily.

The crude protein is determined by breaking down the sample with powerful reagents which convert the nitrogen into ammonia. The nitrogen in the ammonia is then determined and the quantity found is multiplied by 6.25 to convert the results into crude protein.

It is evident that any lengthy description of analytical methods would be out of place here, so it must suffice to say that the methods followed are those of the official agricultural chemists. Every analysis has been repeated in duplicate. And if any doubt then existed concerning the results obtained, duplicate determinations have been repeated until no further doubt remained. Moreover, the most scrupulous care has been exercised in preparing all solutions and in testing all reagents employed in the analyses.

DIGESTIBILITY OF PLANT CONSTITUENTS.

It has been found that only a portion of each of the several constituents is digestible. The amount that is actually digested by animals has been determined by analyzing a portion of the fodder to be tried. A weighed quantity is then fed and the excreta of the animal is again subjected to analysis. Such digestion determinations have been mostly made by German chemists, although a few (about fifty) have been made by American chemists. It is to be regretted that the coefficients of digestibility can not be attached to each analysis.

The following table is a compilation taken from both German and American sources. While much is left to be desired it is safe to say that an intelligent use of this table will be more economical than any guess work that the most skillful feeder can do. The numbers given indicate the per cent of each constituent that is digestible;

Coefficients of Digestibility.

Name of feeding stuff.	Crude protein—per cent.	Fat or ether extract—per cent.	Nitrogen-free extract—per cent.	Crude fibre—per cent.
Crimson clover hay	69	49	72	49
Red clover hay	49	43	58	48
Alsike clover hay	56	53	64	46
Whole corn fodder	54	71	64	69
Corn stover	51	52	63	67
Blue joint	57	37	43	37
Timothy hay	49	56	64	53
Red top hay	60	44	59	61
Orchard grass hay	60	57	57	66
Witch grass	64	60	62	68
Mixed hay	48	50	57	48
Oat straw	38(?)	38	53	58
Wild oat grass	49	38	62	65
Vetch hay	76	60	66	54
Alfalfa hay	77	54	64	49
Wheat straw (Horses)	19	......	18	27
“ “ (Ruminants)	17	36	39	56
Rye straw, (Ruminants)	21	32	37	60
Barley straw “	20	42	54	56
Oats (Horses)	79	70	74	20
Barley (Horses)	80	42	87	100
Barley meal (pigs)	78	68	90	12
Corn (Ruminants)	79	85	91	62
“ (Pigs)	68	46	89	38
Pea meal (Pigs)	88	49	96	71
Wheat	78	82	76	76
Wheat bran “ midlings	78	73	66	18
Linseed cake	86	90	80	44
Potatoes (Pigs)	73	......	98	55
Sugar beets (Ruminants)	62	......	95	......
Mangels (Ruminants)	76	......	95	......
Turnips “	57	......	89	......
Skimmed milk (Pigs)	96	95	99	......

AMOUNT OF CONSTITUENTS REQUIRED BY ANIMALS.

An animal requires different amounts of nutritive substances depending upon what is required of the animal. Different kinds of animals also require varying amounts. The following table is of German origin and is the one now used in this country. It shows how much of each constituent is required for each 1,000 lbs weight of the animal. If the animal weighs more or less than 1,000 lbs the weight of each constituent must be increased or diminished as the case may be.

FEEDING TABLE.—*Pounds per Day Required for One Thousand Pounds Live Weight.*

Kind of animal.	Total dry organic matter—℔s.	Digestible constituents of the fodder.			Amount of nutritive matter—℔s.	Nutritive ratio.
		Crude protein.	Total carbohydrates, (from fibre and nitrogen-free extract.)	Fat—℔s.		
Oxen at rest in stall……………………	17.5	0.7	8.0	0.15	8.85	1: 12.0
Sheep, wool producing, (coarse breed)….	20.0	1.2	10.3	0.20	11.70	1: 9.0
" " " (finer breed)……	22.5	1.5	11.4	0.25	13.15	1: 8.0
Oxen at medium work…………………	24.0	1.6	11.3	0.30	13.20	1: 7.5
Oxen at hard work……………………	26.0	2.4	13.2	0.50	16.10	1: 6.0
Horses at light work……………………	20.0	1.5	9.5	0.40	11.40	1: 7.0
Horses at medium work….'…………	21.0	1.7	10.7	0.60	13.00	1: 7.0
Horses at hard work……………………	24 0	2.4	12.5	0.60	15.70	1: 6.0
Milch cows…………………………	24.2	2.5	12.5	0.40	15.40	1: 5.4
Fattening oxen, 1st period………………	27.0	2.5	15.0	0.50	18.00	1. 6.5
Fattening oxen, 2nd period……………	26.0	3,0	14.8	0.70	18.50	1: 5.5
Fattening oxen, 3rd period……………	25.0	2.7	14.8	0.60	18.10	1: 6.0
Fattening sheep, 1st period……………	26.0	3.0	15.2	0.50	18.70	1: 5.5
Fattening sheep, 2nd period……………	25 .0	3.5	14.4	0.60	18.50	1: 4.5
Fattening swine, 1st period……………	36.0	5.0	27.5		32.50	1: 5·5
Fattening swine, 2nd period……………	31.0	4.0	24.0		28.00	1; 6.0
Fattening swine, 3rd period……………	23.5	2.7	17.5		20.20	1: 6.5
GROWING CATTLE.—						
Age Months. Average live weight per head.						
2—3 150 ℔s………………	22.0	4.0	13.8	2.0	19.8	1: 4.7
3—6 300 ℔s………………	23.4	3.2	13.5	1.0	17.7	1. 5.0
6—12 500 ℔s………………	24.0	2.5	13..5	0.6	16.6	1: 6.0
12—18 700 ℔s………………	24.0	2.0	13.0	0.4	15.4	1: 7.0
18—24 850 ℔s………………	24.0	1.6	12.0	0.3	13.9	1: 8.0
GROWING SHEEP.—						
5—6 56 ℔s………………	28.0	3.2	15.6	0.8	19.6	1: 5.5
6—3 68 ℔s………………	25.0	2.7	13.3	0.6	16.6	1: 5.5
8—11 76 ℔s………………	23.0	2.1	11.4	0.5	14.0	1: 6.0
11—15 82 ℔s………………	22.5	1.7	10.9	0.4	13.0	1: 7.0
15—20 86 ℔s………………	22.0	1.4	10.4	0.3	12.1	1: 8 0
GROWING SWINE.—Fattening.—						
2—3 50 ℔s………………	42.0	7.5	30.0		37.5	1. 4.0
3—5 100 ℔s………………	34.0	5.0	25.0		30.0	1: 5.0
5—6 125* ………………	31.5	4.3	23.7		28.0	1: 5.5
6—8 170* ………………	27.0	3.4	20.4		23.8	1: 6.0
8—12 250* ………………	21.0	2.5	16.2		18.7	1: 6.5

*Substituted by Americans for the German weights 224, 270 and 350 lbs.

The following table gives the actual amounts required by each animal of the average weight given. This table is useful since it saves computations required by the preceding table in making allowance for the actual weight of the animal.

Pounds per Day per Head.

Kind of animal.		Total dry organic matter—℔.	Digestible constituents of the fodder.			Amount of nutritive matter—℔s.	Nutritive ratio.
			Crude protein.	Total carbohydrates, (from fibre and nitrogen free extract.)	Fat—℔s.		
Growing Cattle.—							
Age. Months.	Average live weight per head.						
2— 3	150 ℔s..................	3.3	0.6	2.1	0.30	3.00	1: 4.7
3 – 6	300 ℔s..................	7.0	1.0	4·1	0.30	5.40	1: 5.0
6—12	500 ℔s..................	12.0	1.3	6.8	0.30	8.40	1: 6.0
12—18	700 ℔s..................	16.8	1.4	9.1	0.28	10.78	1: 7.0
18—24	850 ℔s..................	20.4	1.4	10.3	0.26	11.96	1: 8.0
Growing Sheep.—							
5— 6	56 ℔s..................	1.6	0.18	0.87	0.045	1.095	1: 5.5
6— 8	68 ℔s..................	1.7	0.17	0.85	0.040	1.060	1: 5.5
8—11	76 ℔s..................	1.7	0.16	0.85	0.037	1.047	1: 6.0
11—15	82 ℔s..................	1.8	0.14	0.89	0.032	1.062	1: 7.0
15—20	86 ℔s..................	1.9	0.12	0.88	0.025	1.025	1: 8.0
Growing Swine.—Fattening.—							
2— 3	50 ℔s..................	2.1	0.38	1.50		1.88	1: 4.0
3— 5	100 ℔s..................	3.4	0.50	2.50		3.00	1: 5.0
5— 6	125 ℔s..................	3.9	0.54	2.96		3.50	1: 5.5
6— 8	170 ℔s..................	4.6	0.58	3.47		4.05	1: 6.0
8—12	250 ℔s..................	5.2	0.62	4.05		4.67	1; 6.5

Nutritive Ratio.—In the preceding two tables the term nutritive ratio is used. This ratio expresses the relation between the digestible crude protein and the sum of the other digestible constituents after the fat has been multiplied by 2.5. This sum is some times called the "Carbodydrate Equivalence." The nutritive ratio is determined as follows: From the analysis of any plant the per cent of crude protein is taken. This is multiplied by the per cent that is digestible in that plant.

This gives the first term of the ratio. In a similar manner treat the crude fibre, the nitrogen free extract and the fat or ether extract. This gives the per cent digestible of each of these substances. Now multiply the amount of digestible fat by 2.5 to make it equal in feeding value to the other two and then add in the per cent digestible of the crude fibre and nitrogen-free extract. The sum is the second term of the nutritive ratio. Now the ratio is reduced to its lowest terms by dividing both terms by the first. So the nutritive ratio really means the ratio between the protein and the carbohydrate equivalence. This may be illustrated by example. Take timothy hay. The water and ash do not enter into the computation, so they are neglected.

Crude Protein.......................... 7.92 x .49 = 3.97

This gives the first term of the nutritive ratio.

Ether Extract.................... 3.21 x .56 x 2.5 = 3.93
Crude Fibre.......................30.82 x .53 = 16.35
Nitrogen-free Extract............40.04 x .64 = 26.27
46.55

Now the nutritive ratio is is 3.97:46.55. Dividing both terms by the first the ratio assumes the form in which it is usually expressed, viz: 1:11.7.

COMPOUNDING RATIONS —It is now a universally accepted fact that each animal ought to be fed a properly balanced ration. It matters little what the source of food may be, provided it be wholesome and palatable. In order to facilitate the calculation of a properly balanced ration a table comprising nearly everything a farmer in this state is apt to have at hand by way of grains, by-products, etc., has been compiled and included in this article.

How a ration may be compounded from the tables given can best be illustrated by an example. Suppose we wish to compute a properly balanced ration for a milch cow weighing 1000 pounds. Also suppose a farmer has on hand western wheat grass (Agropyrum glaucum) hay, wheat bran and wheat middlings. The question is to determine how much of these substances should be fed daily.

We turn to the table of feeding standards and we find that a milch cow weighing 1000 pounds should have each day nutrients as follows:

Total dry original matter, 24 lbs; crude protein, 2.5 lbs; carbohydrates, 12.5 lbs; fat, .8 lbs. This has a nutritive ratio of 1:5.4. If the animal weighs more or less allowance must be made for the different weight.

Let us take say 20 lbs of the hay, 5 lbs of the bran and 4 lbs of the middlings and compute what quantities of the different nutrients will be furnished. In the first place we are met by the difficulty that no digestion coefficients have been determined for the wheat grass hay so we are compelled to take a hay supposably similar in this respect. Let us take orchard grass hay coefficients.

Now by turning to the analysis of wheat grass (Agropyrum glaucum) hay we find the per cent of nutrients it contains. Multiplying the different constituents by the proper coefficients and then multiplying the results by 20, the proposed number of pounds of hay, we find that the hay furnishes digestible nutrients as follows:

	Tot. Dry Org. Mat.	Crude Protein.	Carbohydrates.	Fats.	Nut. Ratio.
20 lbs hay.......	16.8	1.18	7.0	.3	1:5.4
5 " bran......	4.4	.6	2.5	.2	
4 " middlings.	3.5	.5	1.6	.1	
	24.7	2.3	11.1	.6	

The bran and middlings required the same computations as the hay. We find that the ration comes pretty close to the standard. In case it had varied very widely, from this ration as a basis, the next trial would have brought it closer. It will be noticed that we have obtained a little too much dry matter and fats and not quite enough crude protein and carbohydrates. But the excess of fat will go towards making up the deficiency of the carbohydrates. We also notice that the nutritive ratio is the same as the standard.

But it ought to be said right here that it is very difficult to compound a proper ration without using some such substance as cotton seed meal or linseed cake, substances which have a very narrow ratio. And again it ought to be said that in a state which raises so much flax as does South Dakota, linseed cake ought to be both cheap and plentiful everywhere. The erection of oil mills is most desirable on this account. Again it might be objected that too much hay entered into the composition of the ration. That is true and can be remedied by raising corn fodder, mangels, peas, etc.

There is one thing further that may need explanation and that is how the dry matter was obtained in the foregoing ration. The sum of the per cents of the water and ash in the hay used in the ration was substracted from 100 per cent and the number of pounds of that hay was multiplied by the difference. The same computations were made for the bran and middlings.

In order that the analyses of a large variety of food stuffs may be at hand to cover all cases likely to arise in this state the following analyses have been compiled:

Analysis of Feeding Stuffs.

Kind of Food.	Air dry substance.					
	Water.	Ash.	Protein.	Fibre.	Nitrogen-free extract.	Fat.
Corn fodder	42.2	2.7	4.5	14.3	34.7	1.6
Corn stover	40.1	3.4	3.8	19.7	31.9	1.1
Oat straw	9.2	5.1	4.0	37.0	42.4	2.3
Wheat straw	9.6	4.2	3.4	38.1	43.4	1.3
Rye straw	7.1	3.2	3.0	38.9	46.6	1.2
Barley straw	14.3	4.4	3.4	41.8	34.7	1.4
Oats	11.0	3.0	11.8	9.5	59.7	5.0
Barley	10.9	2.4	12.4	2.7	69.8	1.8
Dent corn	10.6	1.5	10.3	2.2	70.4	5.0
Flint corn	11.3	1.4	10.5	1.7	70.1	5.0
Pea meal	10.5	2.6	20.2	14.4	51.1	1.2
Wheat	10.4	1.9	12.5	1.8	71.2	2.2
Wheat bran	11.5	5.4	16.1	8.0	54.5	4.5
Wheat middlings	12.1	3.3	15.6	4.6	60.4	4.0
Linseed cake, (Old process)	9 2	5.7	32.9	8.9	35.4	7.9
Cotton seed meal	7.7	6.7	38.8	6.3	30.2	10.3
Potatoes	78.9	1.0	2.1	.6	17.3	.1
Sugar beets	86.5	.9	1.8	.9	9.8	.1
Mangels	90.9	1.1	1.4	.9	5.5	.2
Turnips	90.5	.8	1.1	1.2	6.2	.2
Skimmed milk	90.4	.7	3.3	......	4.7	.9

In conclusion it may be said that a proper use of this Bulletin will be of advantage to every farmer in this state. By its aid he will be able to identify the different species of forage plants, to determine which ones are probably best adapted to his locality, to determine what accompanying grains, etc., each one requires for feeding purposes, and it is to be hoped that an intelligent use of the data furnished will lead to a more varied and scientific system of farming.

JAS. H. SHEPARD, Chemist.

LITTLE BLUE STEM.

(*Andropogon scoparius* Michx.)

Stems in bunches, from coarse, strong roots; usually reddish or purplish but sometimes pale; 1 to 4 feet high, with several to many erect branches extending from the sheaths; leaves many, smooth with rough edges, usually rather short, sharp pointed, becoming rigid; flowers in slender, silky spikes which are solitary at the ends of the branches of the stem, and which often become purplish; spikelets sessile, from ¼ to nearly ½ inch in length; empty glumes sharp pointed, the upper with long white hairs along the margins; awn twisted about twice the length of the glume bearing it. Plate 1. Easily recognized by its reddish or purplish appearance and by its habit of growing in bunches. It is called "broom sedge" in the south and often goes by the name of "bunch grass" on the western plains. It is found plentifully throughout the state and is one of the commonest grasses in the basins of the Bad Lands. Early in the season it no doubt furnishes a considerable amount of feed, but in this dry climate it becomes woody so soon that it is unfit for late grazing or hay, while stock refuses to eat it as long as any other grass can be had. It is hardly worthy of cultivation. The specimens analyzed were collected at Brookings.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	5.13	——
Ash	5.08	5.35
Ether Extract	2.26	2.38
Crude Fibre	32.63	34.39
Crude Protein	4.56	4.81
N.-free Extract	50.34	53.06
Total Nitrogen	.73	.77
Albuminoid Nitrogen	.71	.75

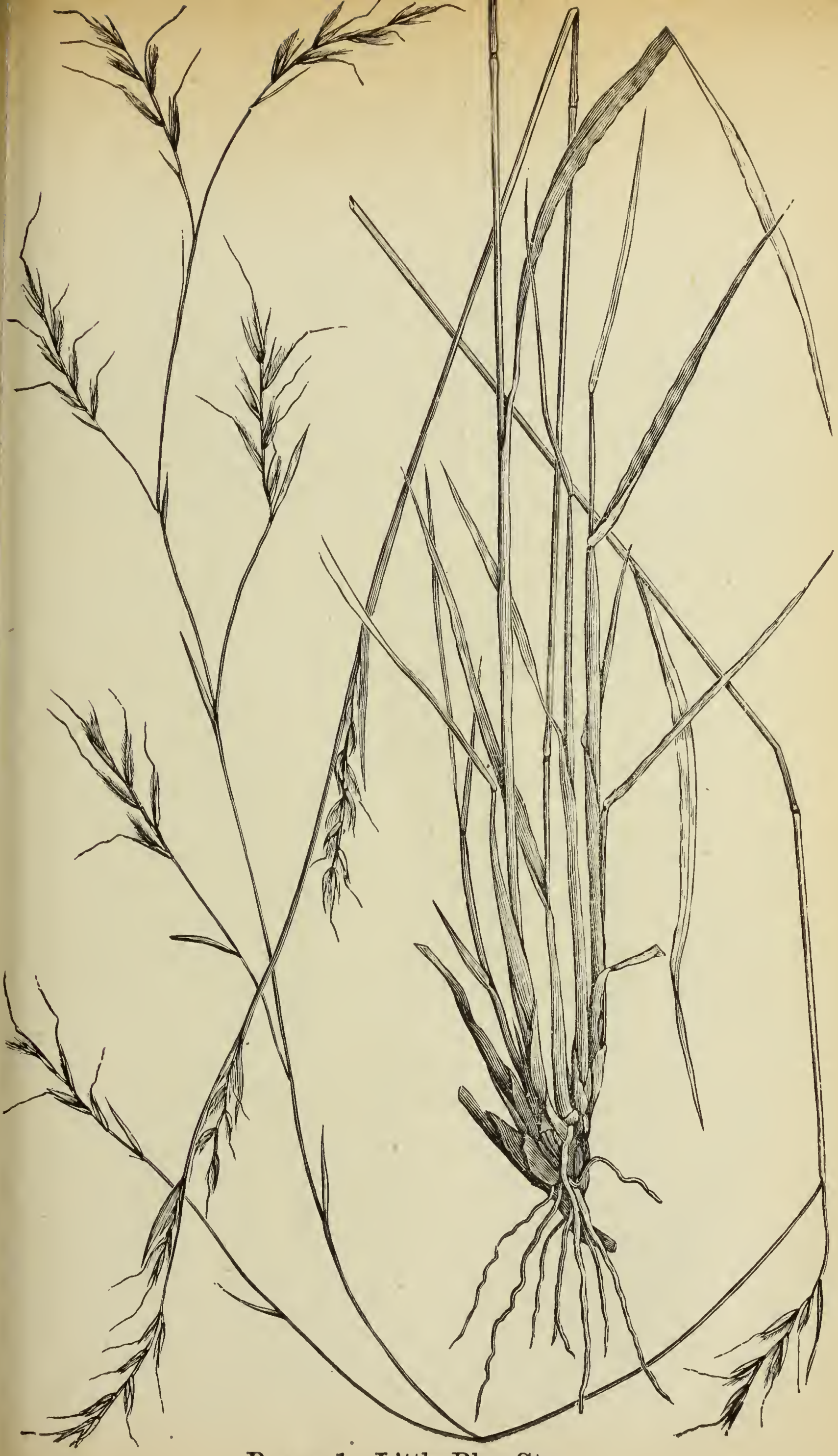

PLATE 1—Little Blue Stem.

BIG BLUE STEM.

(*Andropogon provincialis* Lam.)

Roots perennial, very coarse, from short thick root stocks. Stems large, 3 to 6 feet high, more or less purplish, branched; each branch bearing at its top a cluster of 2 to 5 somewhat hairy, usually purplish spikes; leaves large, flat, roughish, usually a large cluster of root leaves at the base of the stem; spikelets of two sorts, one sessile and awned, the other stalked and awnless. Plate 2.

This grass may be known by its large purple stems, not in dense bunches, and clusters of purplish somewhat hairy spikes. It and some of its near relatives are sometimes called "Turkey-foot grass" because of the fancied resemblance of the clusters of spikes to a turkey's foot. It is found throughout the State on rich prairie soil. It is much more common in the Sioux Valley Region than elsewhere, but is gradually spreading to the westward. Some places along the Missouri river are already well covered by it. It is one of our most important native grazing and hay producing grasses. Under ordinary conditions it produces an abundance of root leaves. When the grass is cut before the stems become woody stock eat them as readily as the leaves. It is well worth fostering in every possible way. The specimens analyzed were collected in Brookings county.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.44	——
Ash	4.16	4.49
Ether Extract	1.86	2.01
Crude Fibre	33.88	36.60
Crude Protein	4.26	4.60
N.-free Extract	48.40	52.29
Total Nitrogen	.68	.74
Albuminoid Nitrogen	.67	.72

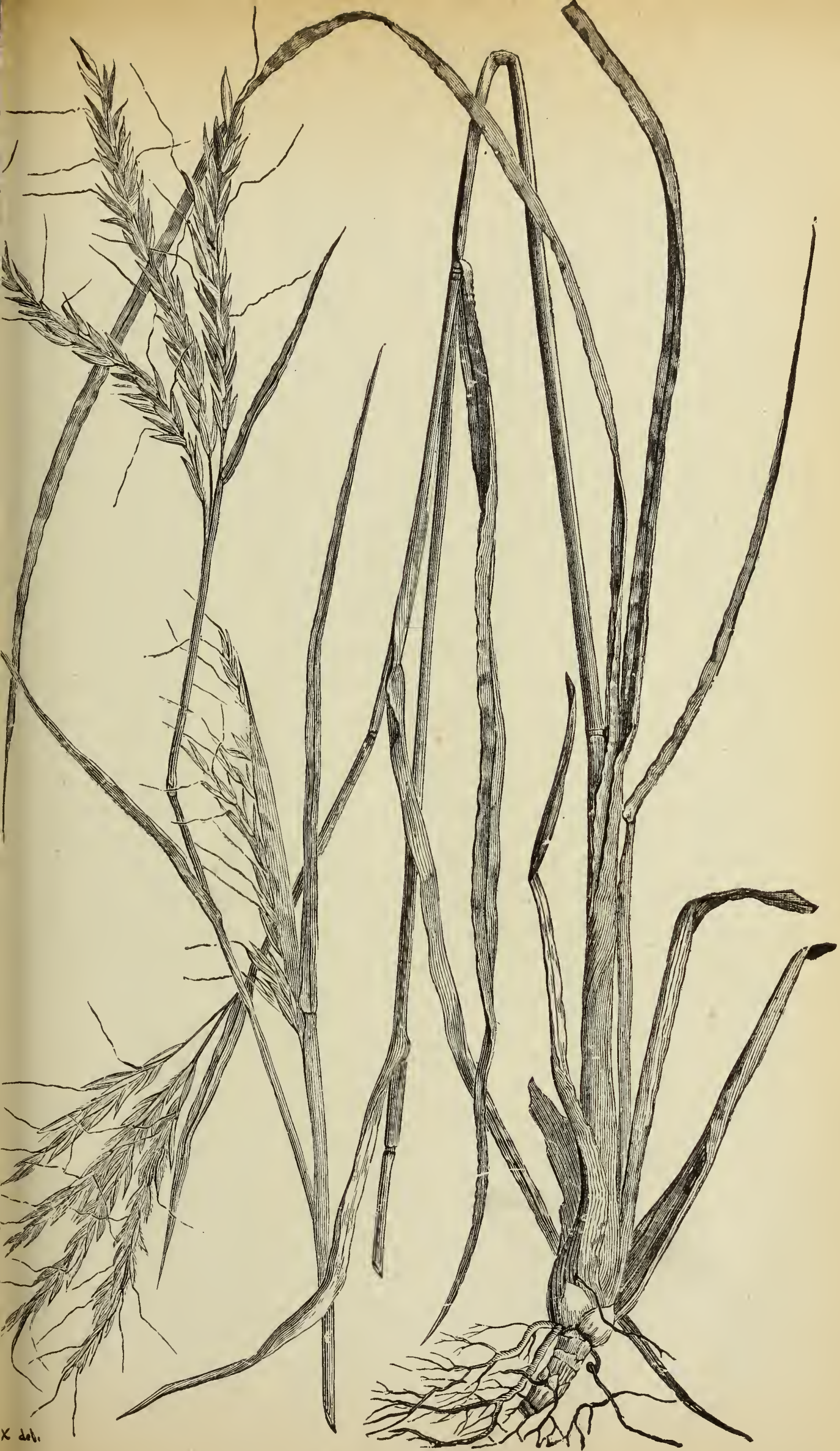

PLATE 2—Big Blue Stem.

BUSHY BLUE STEM.

(*Andropogon nutans* L.)

Roots perennial from robust root-stocks; stems unbranched 2 to 5 feet high, green or purplish, hairy at the joints, leaves large and broad, roughish, tapering to a sharp point; upper sheaths smooth, lower often hairy; flowers in a bushy panicle, yellowish, reddish or purplish brown; spikelets hairy, the fertile ones with long, bent and twisted awns; panicle 6 inches to a foot in length. Plate 3. May be distinguished from our other blue stems by its bushy inflorescence and less purple stems. It occurs throughout the state, but is most plentiful in the Eastern and Southeastern parts. It yields an abundance of excellent hay and is particularly valuable because of the relatively large amount of long root-leaves which are produced. All stock eat it greedily. It may well be given the first place among our native grasses as a hay producing species. It thrives best on rich prairie bottoms. During dry seasons it produces but little seed though it usually makes a good growth of root leaves. The specimens analyzed were collected at Brookings.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.75	———
Ash	6.40	6.94
Ether Extract	1.57	1.70
Crude Fibre	34.73	37.64
Crude Protein	3.85	4.17
N.-free Extract	45.70	49.54
Total Nitrogren	.62	.67
Albuminoid Nitrogen	.58	.62

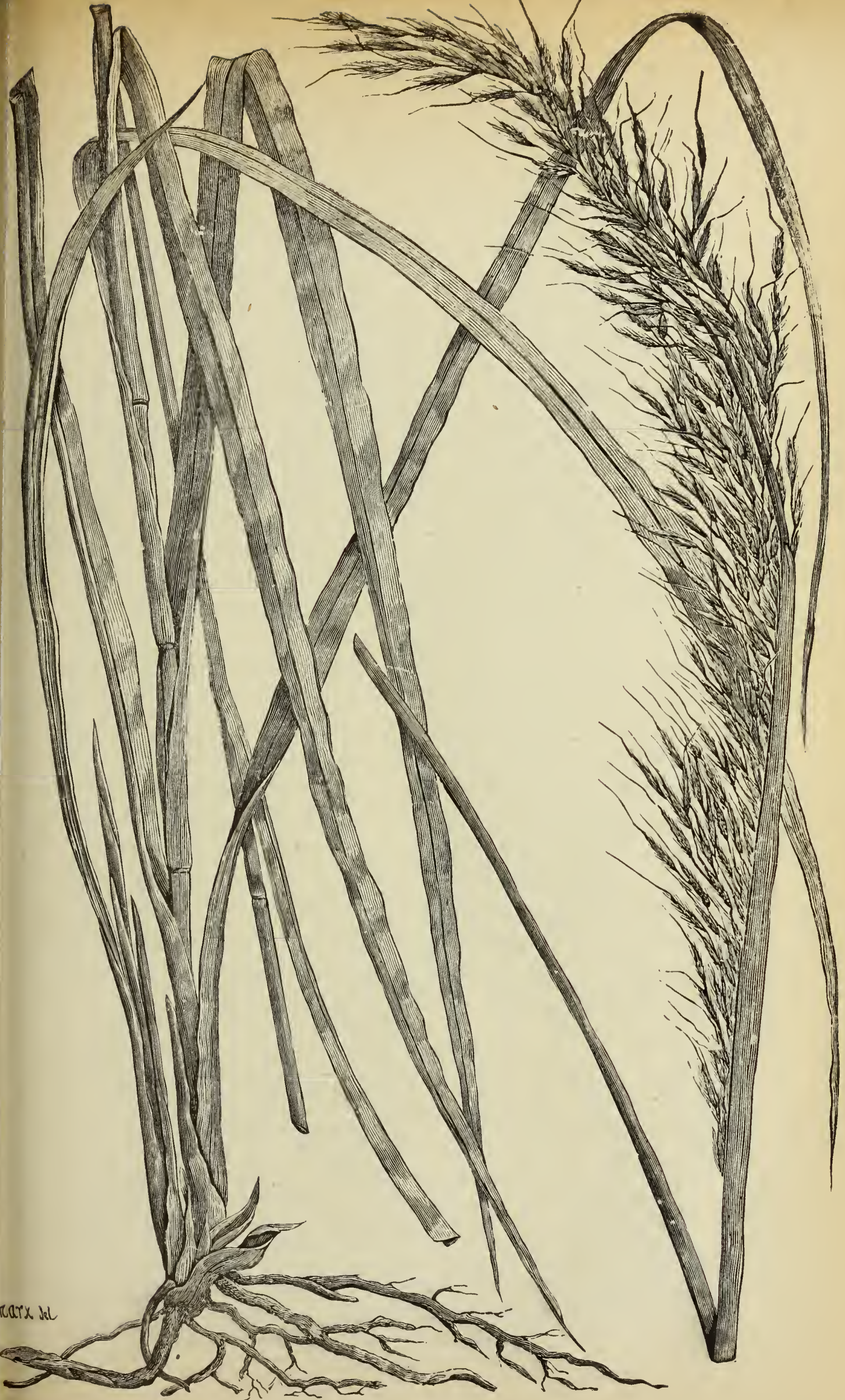

Plate 3—Bushy Blue Stem.

JOHNSON GRASS.

(*Andropogon sorghum* Brot., *var. halapensis* Hack.)

Stems tall and coarse, 3 to 6 feet high, from stout, deep-growing roots, green, some times branching; leaves very large and broad, smooth, long pointed; flowers in large, green or some times purplish, bushy panicles which are often as much as 1½ feet in length; spikelets more or less clustered on the branches of the panicle, usually covered with short, appressed hairs; fertile flowers with long twisted awns bent at the middle. Plate 4.

This grass is a native of the Old World and is grown quite extensively in the South, where it is a very valuable forage plant. It thrives well on a variety of soils and endures well both drouth and floods. When once well established in a field it is difficult to eradicate and hence may become a pernicious weed under certain circumstances. Several attempts have been made to grow it on the Station grounds but all have been unsuccessful. Our springs are so cold that it is almost impossible to get a good stand and when once started it cannot withstand the severe cold of winter. It is therefore to be regarded as of no value for this region. The specimens analyzed were cut on the college farm on the 9th of August, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	9.86	———
Ash	5.71	6.33
Ether Extract	2.71	3.01
Crude Fibre	29.17	32.36
Crude Protein	12.77	14.17
N.-Free Extract	39.78	44.13
Total Nitrogen	2.04	2.27
Albuminoid Nitrogen,	1.55	1.72

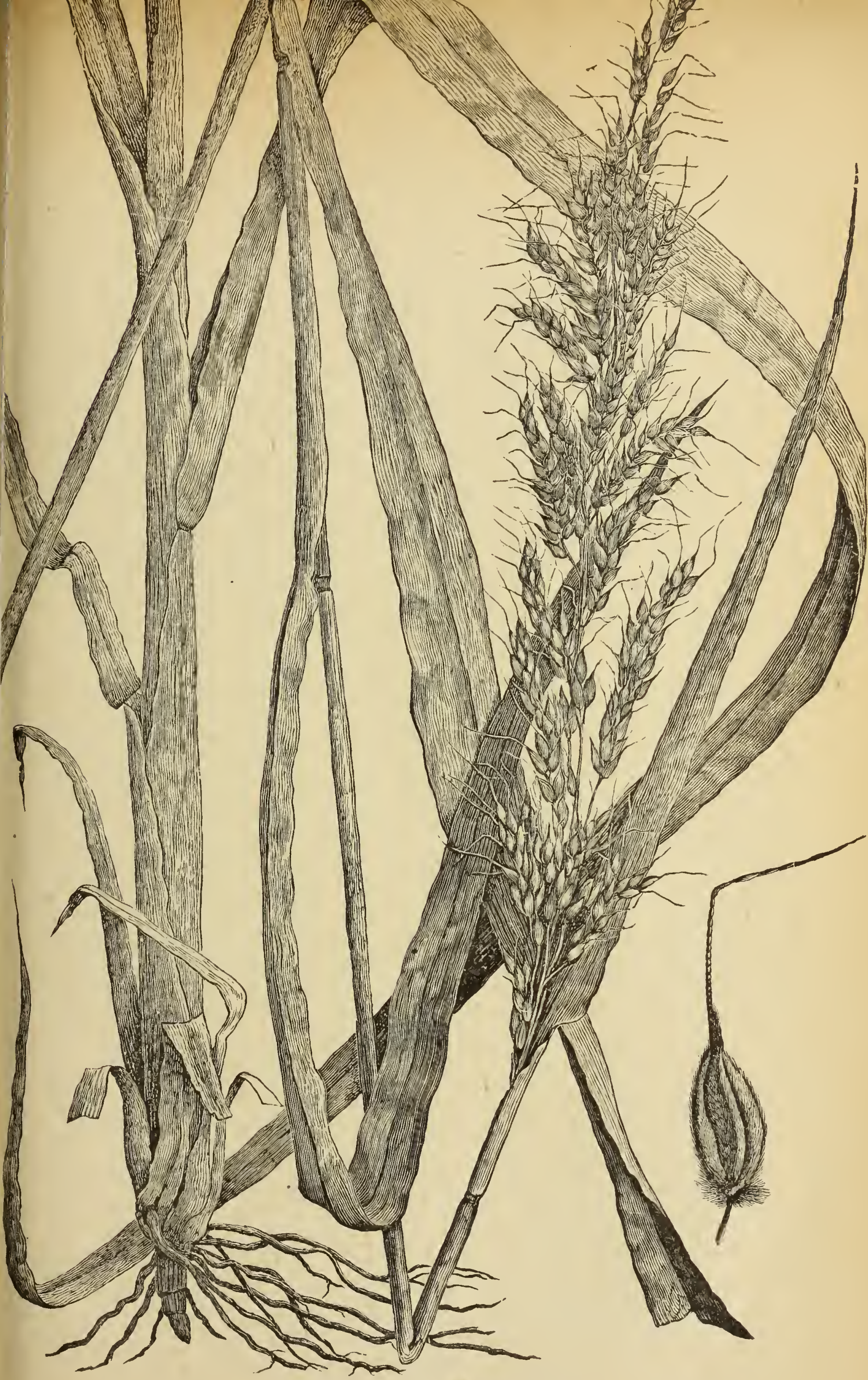

Plate 4—Johnson Grass.

DWARF PANIC GRASS.

(*Panicum depauperatum* Muhl.)

Stem erect, from perennial roots, tufted, unbranched, from 4 to 16 inches high; leaves erect, 3 to 6 inches long, narrowly linear, sharp pointed, more or less soft hairy, particularly on the sheaths; flowers in small contracted panicles which are from one to two inches long and are borne on short flower stalks when they are overtopped by the leaves, or, later in the season, on elongated flowerstalks when they considerably exceed the leaves; spikelets one-eighth of an inch or less in length, obovate, hairy; lower glume about one-third the length of the upper ones, which are 7 to 9 nerved.

Rather an insignificant grass occurring throughout the state on upland meadows. It is perhaps most plentiful in the Sioux Valley where it forms no small part of the native forage. This is a very nutritious grass and is eaten readily by all kinds of stock. In many parts of the country where fields have been allowed to go back the panic grasses soon take possession. After a time, however, they are crowed out by other and stronger growing grasses, as the wheat grasses and blue stems. Neither this nor the following species is worthy of cultivation. The specimens analyzed were collected at Brookings, June 25th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	5.06	——
Ash	12.42	13.08
Ether Extract	4.68	4.93
Crude Fibre	27.45	28.91
Crude Protein	8.68	9.14
N.-free Extract	41.71	43.93
Total Nitrogen	1.39	1.46
Albuminoid Nitrogen	.99	1.04

SMALL PANIC GRASS.

(*Panicum scoparium* Lam.)

Stems tufted, at first erect but often becoming reclining and branched, from a perennial root, somewhat roughened, from eight inches to two feet high; leaves upright, about three inches long and one-third of an inch wide, nerves more or less apparent, smooth with rough margins; sheaths and often the margins at the base of the leaves hairy; panicle two to three inches long, spreading, with alternate, simple, smooth branches; spikelets few, borne at the ends of the slender branches, about one-eighth of an inch long, obtuse, hairy.

This grass is quite common in the Eastern part of the state, particularly in the Sioux Valley. It is also common in the Black Hills Region, but seems to be of much rarer occurrence in the prairie regions of the central part of the state. In the Sioux Valley a form is common which seems to be intermediate between this species and *Panicum clandestinum.* In many parts of this region small panic grass, and dwarf panic grass, furnish a considerable part of our hay. The autumn form of small panic grass is quite different from the earlier form, having the leaves clustered together toward the top of the stems and smaller panicles more or less included in the sheaths. The specimens analyzed were collected at Brookings, June 20th, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.83	——
Ash	8.88	9.74
Ether Extract	1.71	1.88
Crude Fibre	29.64	32.51
Crude Protein	9 97	10.94
N.-free Extract	40.97	44.94
Total Nitrogen	1.59	1.75
Albuminoid Nitrogen	1.06	1.16

SWITCH GRASS.

(*Panicum virgatum* L.)

Stem stout, erect, from strong, perennial, creeping, scaly root-stocks, two to five feet high; leaves large, a foot or more long and one-fourth to nearly one-half an inch wide, flat, smooth except on the margin, sheaths often purplish; panicle very large, branched and spreading, or often drooping, from six inches long in the smaller forms to a foot and a half in the larger ones, often purplish; spikelets pointed, smooth, about one-seventh of an inch long, on rough pedicels; lower glume one-half to two-thirds as long as the upper one; glumes all sharp pointed. Plate 5.

One of the most valuable of our native grasses. It occurs throughout the state on dry and sandy as well as on rich, moist soils, though it much prefers the latter sort. In the Sioux and James Valleys it forms a large part of the hay. It promises to do well under cultivation giving a good yield of excellent hay if cut in proper season. If allowed to stand too long before cutting, it becomes harsh, woody and unpalatable. It is a very variable species. On the uplands the common form is usually smaller and quite glaucous (var. *glaucum* Vasey.) In the western part of the state a form with a close, oblong panicle (var. *confertum* Vasey) is not uncommon, while another with long, narrow panicles, and spikelets an eighth of an inch long (var. *elongata* Vasey) is of rarer occurrence. In many parts of the country this grass is known as "false red top," "tall panic grass," and "black bent." The ease with which the seed may be obtained and the other excellent qualities of this grass make it a species well worthy of cultivation. The specimens analyzed were collected at Brookings July 15th, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.29	....
Ash	6.50	7.01
Ether Extract	2.09	2.25
Crude Fibre	33.89	36.55
Crude Protein	6.24	6.73
N.-free Extract	43.99	47.45
Total Nitrogen	.99	1.08
Albuminoid Nitrogen	.88	.95

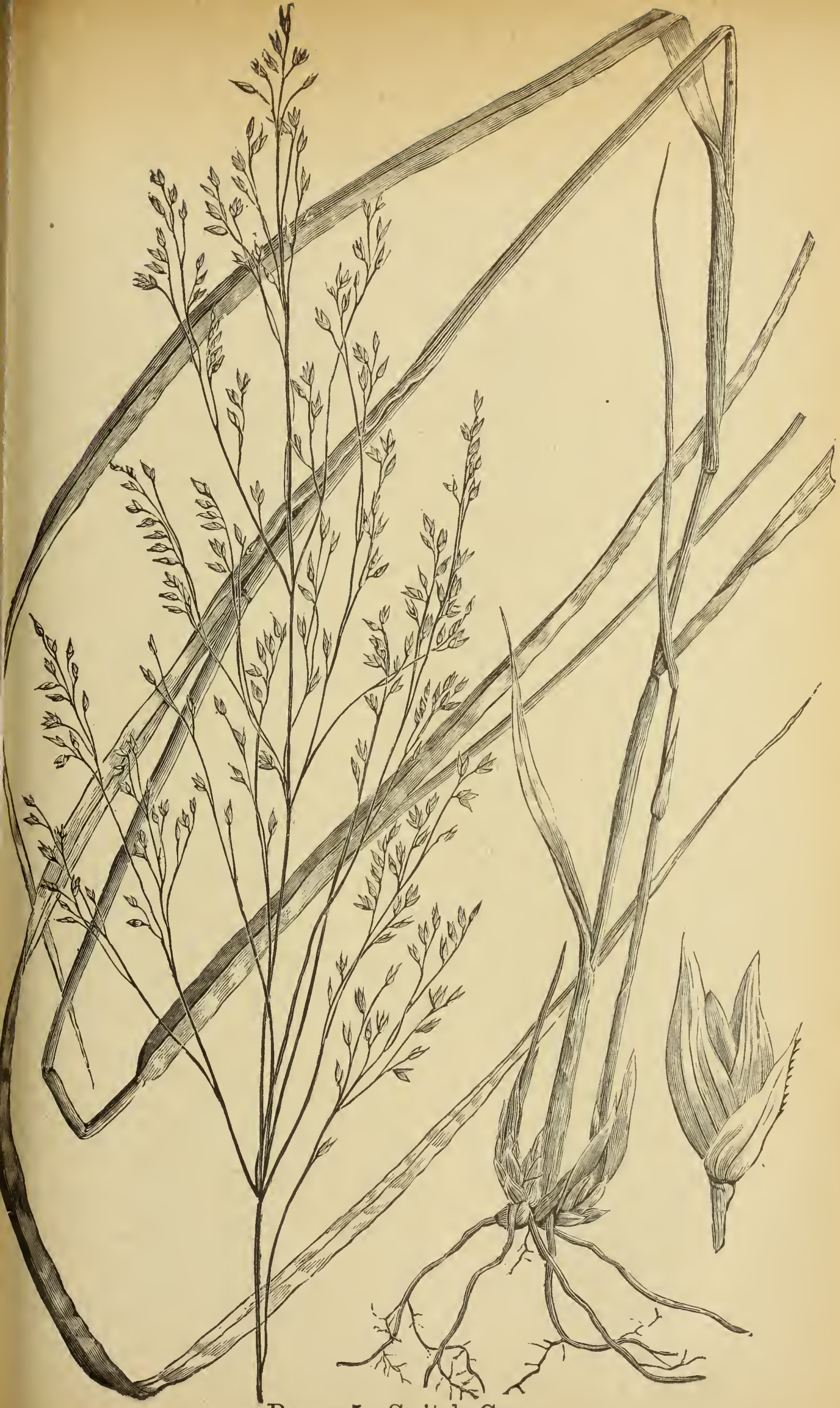

PLATE 5—Switch Grass.

BARN-YARD GRASS.

(*Panicum crus-galli* L.)

Stems coarse, usually decumbent, branching, one and one-half to four feet high; leaves large, six inches to a foot long and one-fourth to nearly three-fourths of an inch wide, rough; sheaths smooth or hairy; panicle dense with numerous spike-like branches upon which are crowded the usually rough spikelets; outer glumes either with or without a hispid awn of varying length. Plate 6.

A common, weedy grass occurring throughout the state. It is a native of the Old World. Though usually considered as a weed, if properly handled it yields large quantities of a very nutritious hay. It should be cut when it first begins to bloom. As a weed it is easily kept in check. In some of the Southern States it is much prized as a forage plant often yielding four or five tons of hay to the acre. As it usually re-seeds itself from year to year it is easily grown. It will probably never be so valuable here in the north. Besides the common form two other varieties occur in the state; one with the awns of the glume entirely wanting (var. *muticum* Vasey), and another with bristly spikelets, long-awned glumes and very hairy sheaths (var. *hispidum* (Muhl.) Torr.). The specimens analyzed were collected at Brookings, August 8th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.01	....
Ash	9.30	10.09
Ether Extract	2.67	2.90
Crude Fibre	32.72	35.57
Crude Protein	9.40	10.22
N.-free Extract	37.90	41.20
Total Nitrogen	1.50	1.63
Albuminoid	1.28	1.39

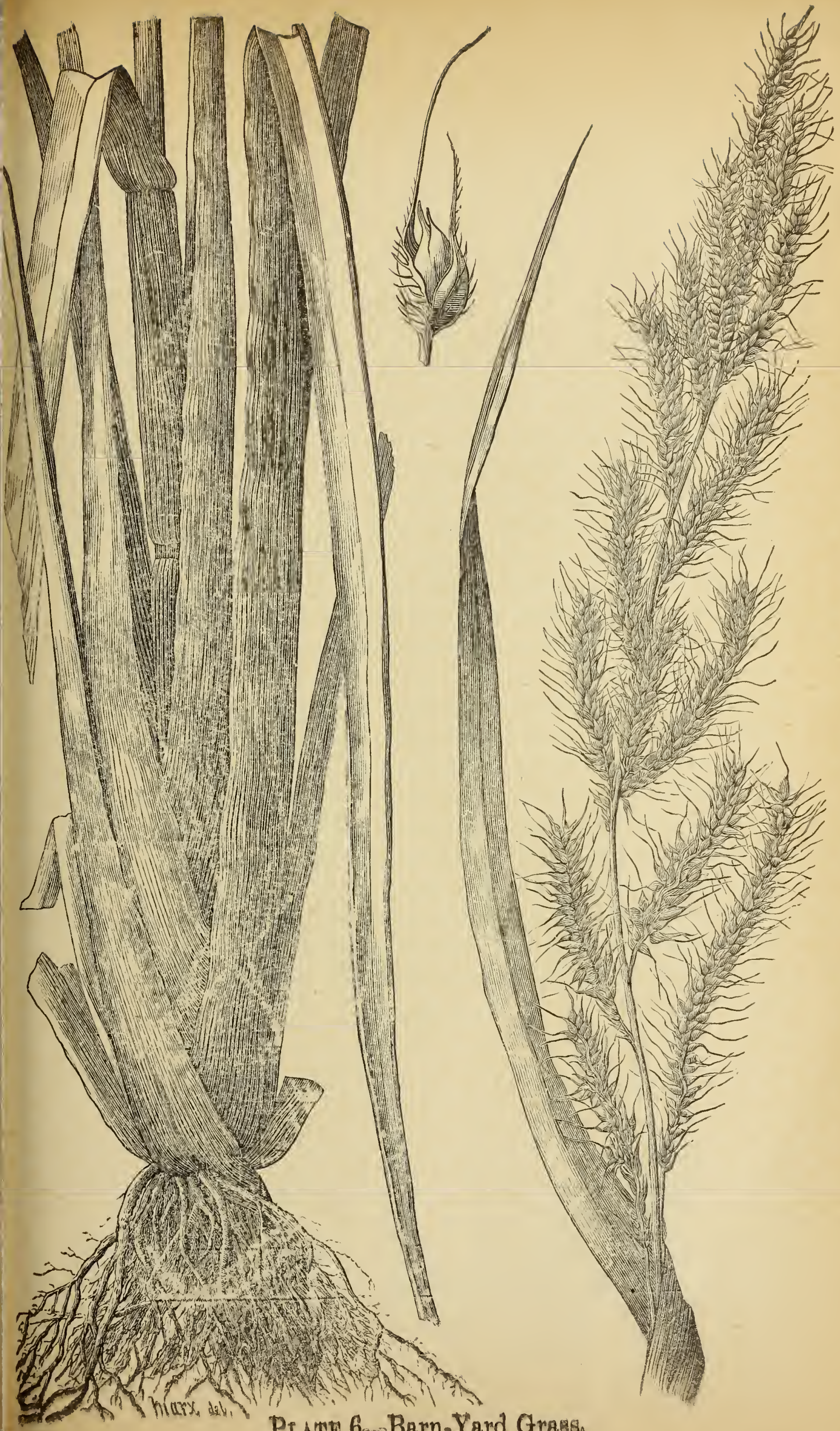

PLATE 6—Barn-Yard Grass.

OLD WITCH GRASS.

(*Panicum capillare* L.)

Stem rather robust, erect or ascending, from an annual root, more or less branching, usually from one to one and a half, or rarely two feet high; leaves four to eight inches long, broad, flat, more or less covered with long hairs, particularly on the sheaths; flowers in very large panicles with wide-spreading, slender branches, often borne on the lateral branches of the stem also; spikelets on long capillary pedicels, smooth, variable in size, from less than one-twelfth to nearly one-sixth of an inch long, pointed.

Common throughout the greater part of the state. It is of little valne as a forage plant and often becomes a weed. In many localities it is known as "tickle grass." The large panicles become free from the remainder of the plant and form "tumble weeds" which are blown about by the wind, often becoming so plentiful as to be quite troublesome. As the plant is an annual it is easily kept down. It is perhaps most useful as a fall forage since it is generally quite plentiful in stubble fields after harvest. The specimens analyzed were collected at Brookings August 12th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.36	——
Ash	11.43	12.34
Ether Extract	2.32	2.50
Crude Fibre	27.09	29.24
Crude Protein	10.58	11.42
N.-free Extract	41.22	44.50
Total Nitrogen	1.69	1.83
Albuminoid Nitrogen	1.30	1.40

BRISTLY FOX-TAIL.

(*Setaria verticillata* (L.) Beauv.)

Stems erect, from annual roots, one to three feet high, branched below; leaves minutely roughened; spike cylindrical, two to four inches long, dense, green; spikelets in dense, irregularly whorled clusters; bristles short, barbed downward, often causing the spikes to adhere to each other thus becoming more or less entangled.

Rare either in cultivation or as an escape. It is a native of Europe. Here in South Dakota it is probably of little importance either as a forage plant or as a weed. Easily recognized by its downwardly barbed bristles and the arrangement of the clustering spikelets. The specimens analyzed were grown on the college grounds and were cut August 6th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.25	——
Ash	12.32	13.43
Ether Extract	2.13	2.32
Crude Fibre	32.25	35.15
Crude Protein	15.77	17.19
N.-free Extract	29.28	31.91
Total Nitrogen	2.52	2.75
Albuminoid Nitrogen	1.55	1.69

GREEN FOXTAIL.

(*Setaria viridis* (L.) Beauv.)

Stem erect, from an annual root, usually unbranched, one and one-half to three feet high; leaves flat, pointed, rough; flowers in spikes which are two to five inches long, green, more or less pointed both above and below; bristles longer than the spikelets, about four to eight in a cluster; flowering glume longitudinally striate and dotted. Plate 7.

An introduced weedy grass found in fields and waste places. When properly cut and cured it furnishes a nutritious hay but the yield is much lighter than millet and the plant is difficult to destroy when once well established in a field. On the whole it is not worthy of cultivation and should be regarded as a bad weed. It can usually be distinguished from other species of the genus by its green, soft-bristly, nodding spikes or heads. Besides the common name given above this grass is known as "bottle grass," "pigeon grass" and "puss grass." The specimens analyzed were cut on the college farm, September 19th, 1891, and were in fruit.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.49	—
Ash	11.11	12.01
Ether Extract	2.49	2.69
Crude Fibre	30.26	32.71
Crude Protein	9.17	9.91
N.-free Extract	39.48	42.68
Total Nitrogen	1.46	1.59
Albuminoid Nitrogen	1.28	1.39

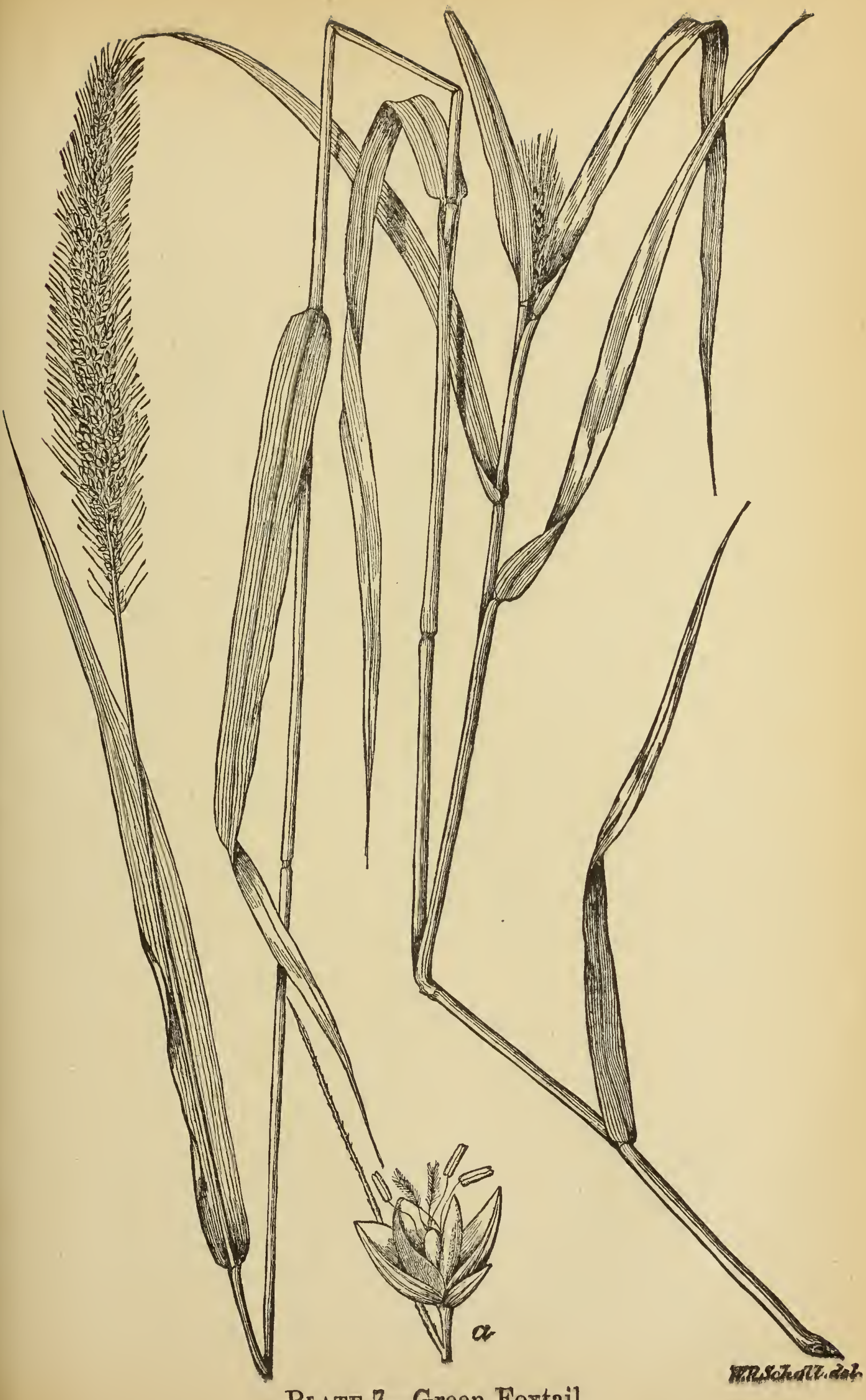

PLATE 7—Green Foxtail.

YELLOW FOXTAIL.

(*Setaria glauca* (L.) Beauv.)

Stems erect, from an annual root, simple or branched at the base, one and one-half to two and one-half feet high; leaves flat, long, roughish or nearly smooth; spike erect, rigid, cylindrical, two to four inches long, tawny yellow; bristles six to ten in a cluster, longer than the spikelets; flowering glume transversely wrinkled. Plate 8.

This, like the preceding, is a native of the Old World which has become introduced throughout the greater part of the state. Its rigid, cylindrical, tawny-yellow spikes serve to distinguish it from the other species of the genus. Like the green fox-tail it is a troublesome weed though it may be made to render some service as a forage plant. Though an annual it produces so many seeds and is such a vigorous grower that it is difficult to rid a field of it when once well started. It is perhaps most troublesome as a weed in small grains and grasses raised for seed. Care should be taken in buying grass seed, particularly timothy, as fox-tail is often present in greater or less quantities. The specimens analyzed were cut on the college farm August 8th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.17	—
Ash	13.40	14.59
Ether Extract	1.88	2.05
Crude Fibre	31.25	34.03
Crude Protein	10.53	11.47
N.-free Extract	34.77	37.86
Total Nitrogen	1.69	1.83
Albuminoid Nitrogen	1.11	1.21

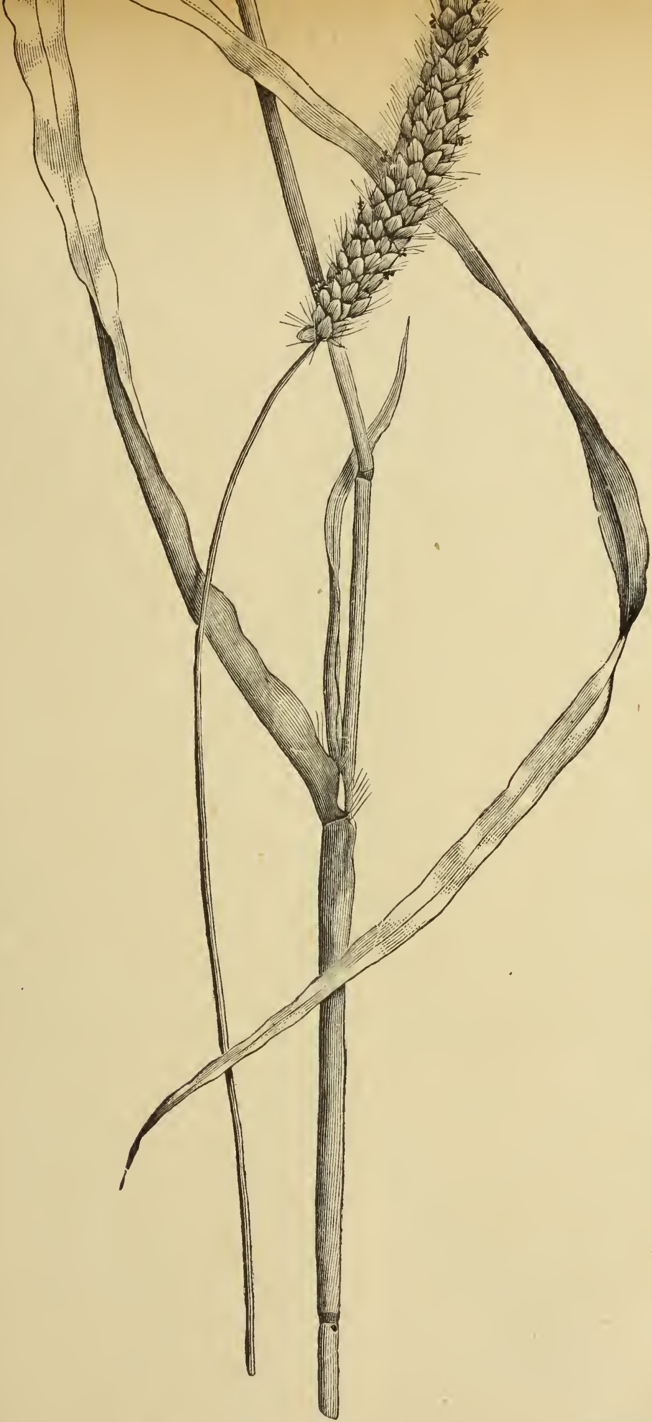

Plate 8—Yellow Foxtail.

MILLET.

(*Setaria italica* (L.) Kunth.)

Stems erect, from annual roots, unbranched, one and one-half to four feet high; leaves very long and broad, rough; spike usually large, from two inches long in the smaller forms to eight or ten inches long and more or less compound in the larger and more highly cultivated ones, oblong or cylindrical, usually yellowish or purplish and nodding; bristles either longer or shorter than the spikelets. Plate 9.

This is one of the most useful of our cultivated annuals. There are many different varieties in cultivation such as German millet, Hungarian grass, Golden millet, etc. As it is usually ready for cutting (if for hay) in from two to two and one half months after sowing it is an excellent catch crop when others fail, and can be sown after most other crops are in and will then have plenty of time to mature. The yield of hay is usually a heavy one. When used for hay it should be cut as soon as possible after heading. If allowed to stand until the seeds are well formed it is thought to have a bad effect upon the kidneys of animals to which it is fed. On the other hand ground millet seed has been used for fattening hogs with good results. Because of its early maturity and the possibility of its being sown late and harvested early millet is an excellent crop to use in fighting certain pernicious weeds as, for example, the Russian thistle. Cut worms seldom damage it or even the crop following it the next season. The specimens analyzed were cut on the college farm on the 8th of August, 1892.

ANALYSIS.

	Air Dry Substance	Water Free Substance.
Water	8.74	——
Ash	10.19	11.17
Ether Extract	2.96	3.24
Crude Fibre	32.14	35.22
Crude Protein	11.10	12.16
N.-free Extract	34.87	38.21
Total Nitrogen	1.78	1.95
Albuminoid Nitrogen	1.10	1.21

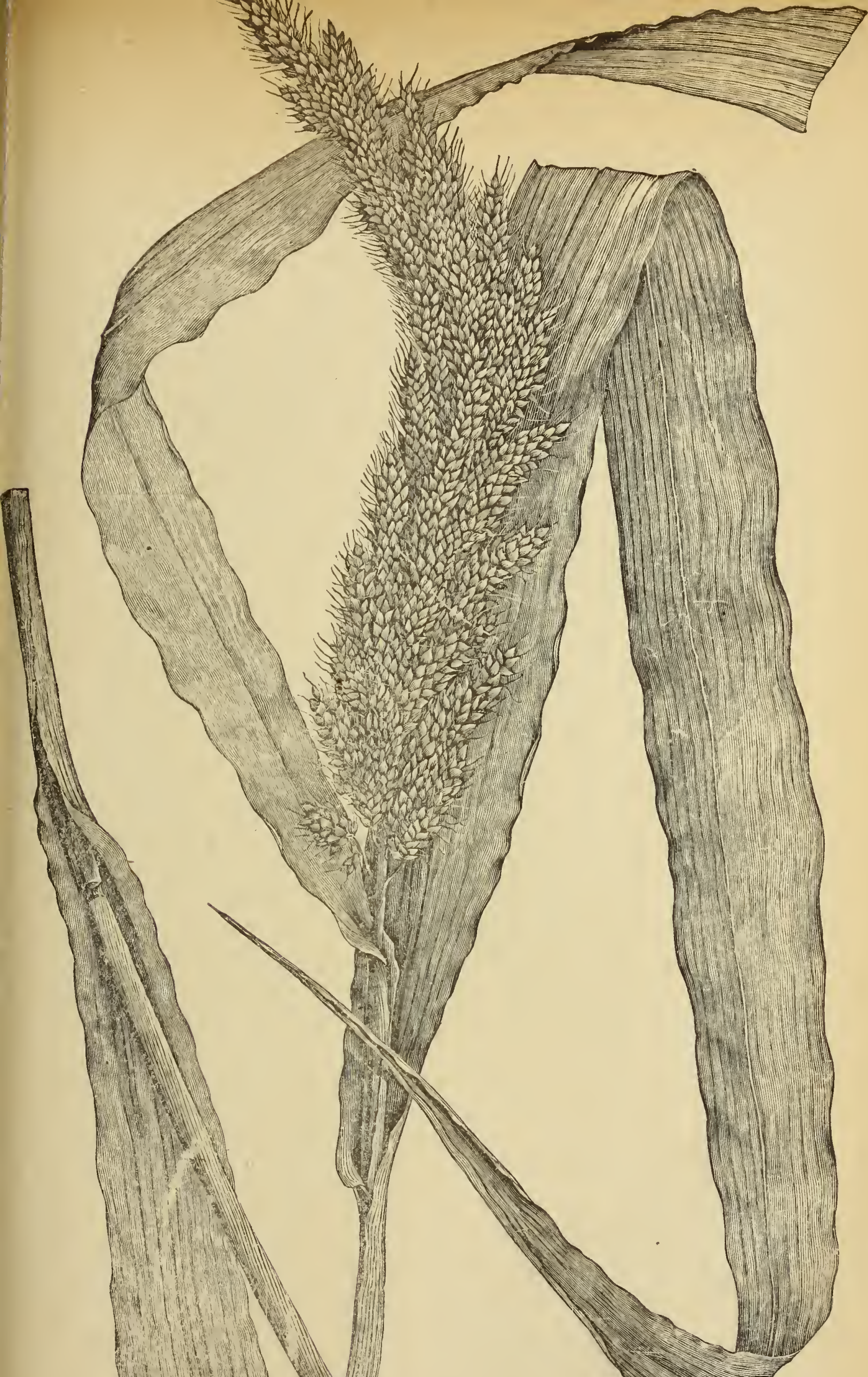

PLATE 9—Millet.

INDIAN RICE.

(*Zizania aquatica* L.)

Stems large, three to nine feet high, from coarse, fibrous, annual roots; leaves large, one and one-half to three feet long and half an inch or more wide, taper-pointed, smoothish or roughened on the margins and mid-rib; panicle large, a foot or more long, pyramidal, the lower, spreading branches bearing staminate flowers and the upper, erect branches bearing pistillate ones; flowerstalks club-shaped; flowering glume of pistillate flowers with a long awn or beard; grain slender, about half an inch long. Plate 10.

This grass is very common in most localities east of the Missouri river. It may occur west of the river but has not yet been reported from there. It grows best in shallow water along margins of streams. The grain is very nutritious and is said to be sometimes used as food by the Indians. It is a favorite food for water fowl of all kinds and is used in game preserves for this purpose. Cattle and horses eat the grass readily but as it grows in such marshy places it is usually so difficult of access that a relatively small amount of it is eaten by them. It will probably never enter very largely into the forage of the state but will always be one of the best grasses for use in lakes and streams of game preserves. The specimens analyzed were collected in the Sioux river, near Brookings, August 10th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.01	———
Ash	12.26	13.18
Ether Extract	2.26	2.43
Crude Fibre	34.88	37.51
Crude Protein	7.24	7.79
N.-free Extract	36.35	39.09
Total Nitrogen	1.16	1.25
Albuminoid Nitrogen	.99	1.06

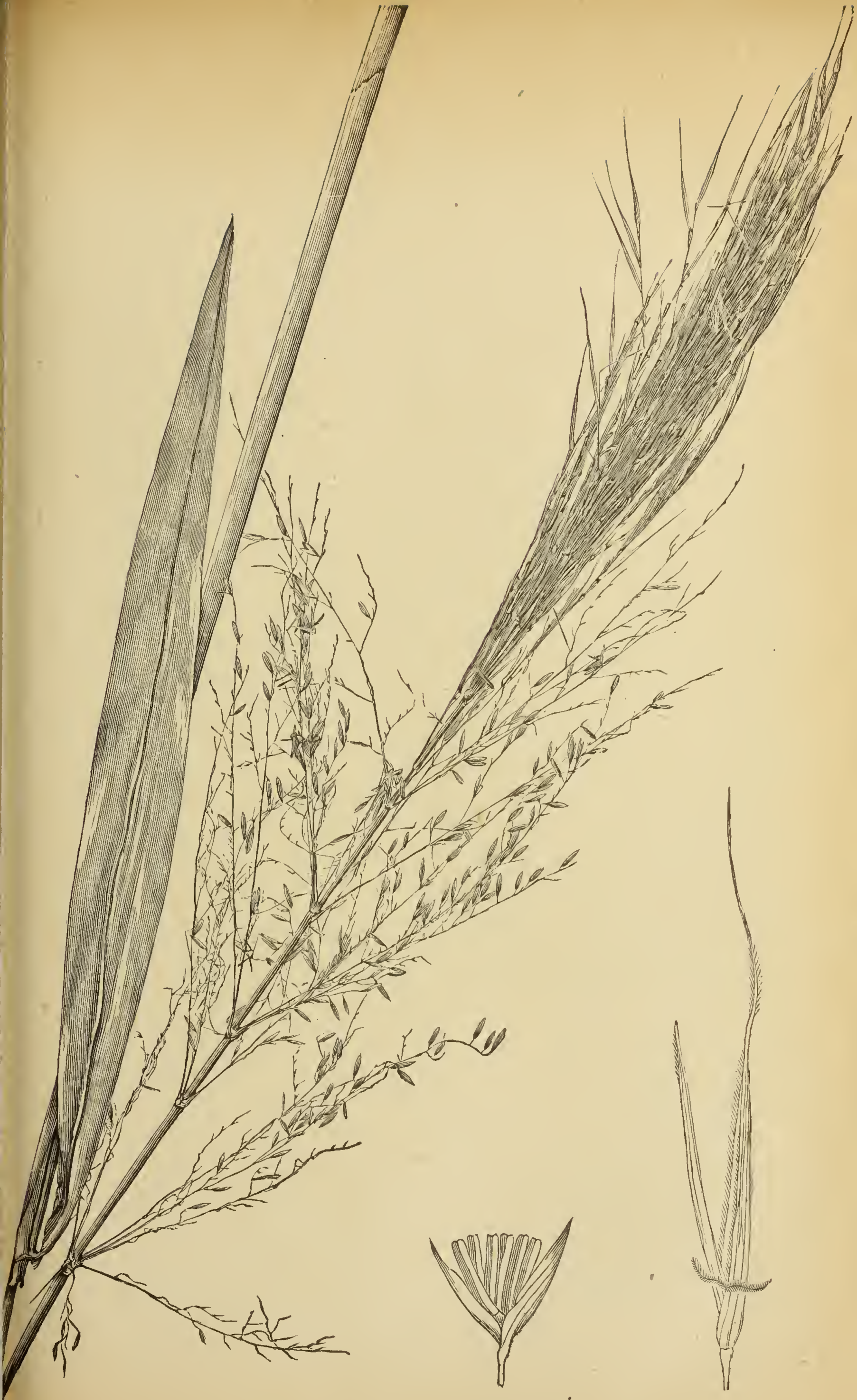

PLATE 10—Indian Rice.

VIRGINIA CUT-GRASS.

(*Homalocenchrus virginica* (Willd.) Britt.)

Stems slender, decumbent, branching below, two to four feet high, from stout root-stocks and fine, fibrous roots; leaves softish, flat, short-pointed, margins only slightly roughened, of a brighter green than those of the preceding species; panicle simple, about five or six inches long; spikelets only about one-eighth of an inch long, greenish, closely appressed to the slender branches of the panicle, the glumes only slightly ciliate on the keel. Plate 11.

Like the preceding species this grass occurs only in wet places and has only been found in the eastern part of the state. It may be distinguished from that species by its shorter, greener, softer leaves, smaller panicles and spikelets and more robust root-stocks. It makes a better quality of forage. It is, however, of comparatively little importance as a forage plant. The specimens analyzed were collected in Brookings county.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	4.68	——
Ash	15.88	16.66
Ether Extract	3.47	3.64
Crude Fibre	28.26	29.65
Crude Protein	5.88	6.17
N.-free Extract	41.83	43.88
Total Nitrogen	.94	.99
Albuminoid	.77	.81

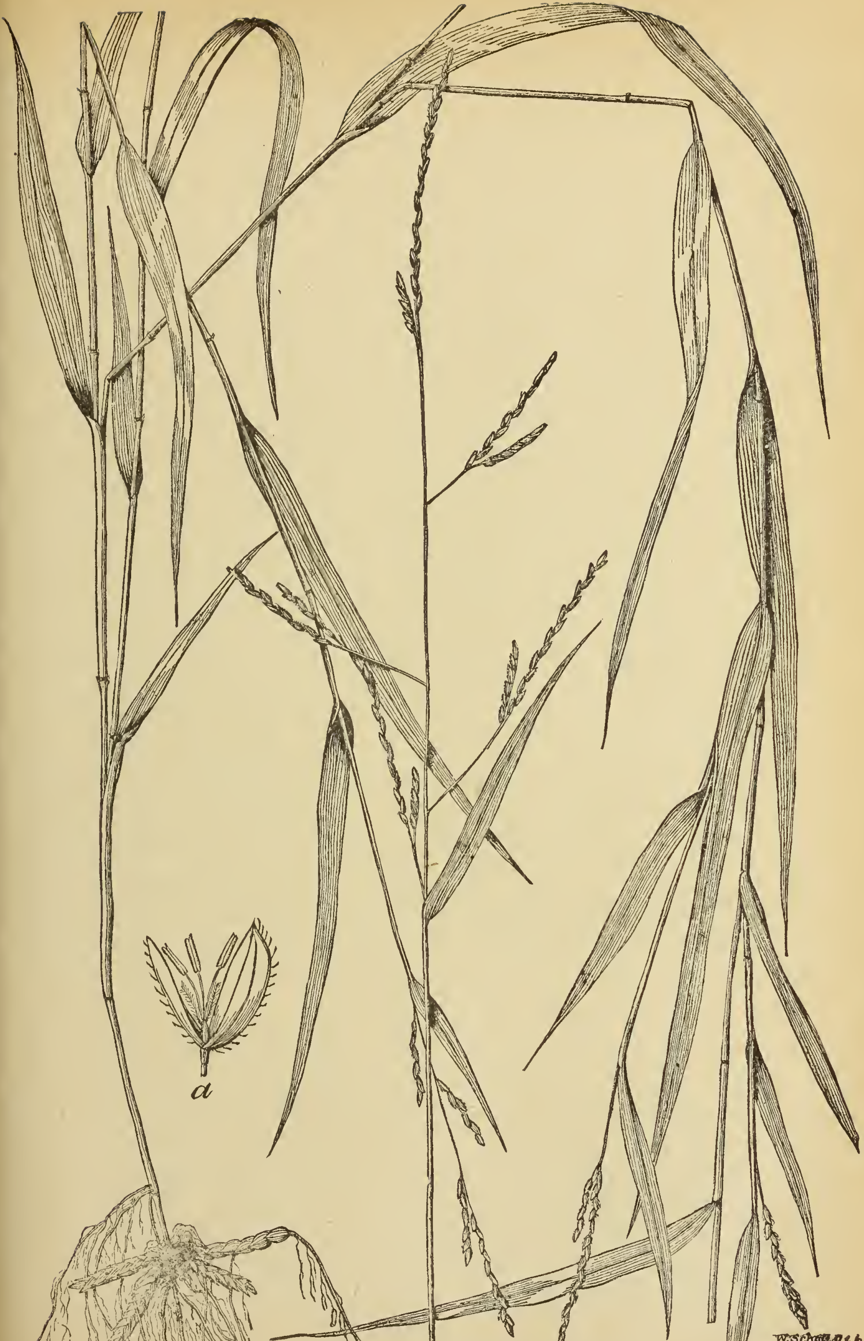

Plate 11—Virginia Cut-Grass.

RICE CUT-GRASS.

(*Homalocenchrus oryzoides* (L.) Poll.)

Stems rather stout, erect or decumbent, more or less branching below, two and one-half to four feet high; with slender, creeping root-stalks; leaves often a foot or more long, from one-fourth to one-half of an inch wide, pale green, with very rough margins; panicle from six inches to over a foot long, diffusely branched; spikelets flat, about one-sixth of an inch long, whitish, the obtuse glumes bristly ciliate on the keel.

Not uncommon in wet places in the eastern part of the state. It may be easily recognized by its peculiar rice-like spikelets and broad, rough-margined leaves which cut into the flesh readily if drawn through the hand or over an exposed part of the body. It is not a good forage plant as it is rather too rough and harsh. Cattle and horses are not very fond of it even when green. Mixed with other grasses it is of some value when cut for hay. As it only occurs in very moist soils it will probably never be of any great value in our state. The analyzed specimens were collected along the Sioux river, near Brookings, the last of August.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	4.93	——
Ash	18.41	19.36
Ether Extract	2.51	2.64
Crude Fibre	26.29	27.65
Crude Protein	7.50	7.89
N.-free Extract	40.36	42.45
Total Nitrogen	1.20	1.26
Albuminoid Nitrogen	1.04	1.09

SWEET VERNAL GRASS.

(*Anthoxanthum odoratum* L.)

Stems slender, from six to eighteen inches high, from perennial roots, smooth; leaves scanty, short (one to three inches long), smooth; infloresence, spike-like, one to three inches long, greenish brown; spikelets three flowered—only one of the flowers (the central one) fertile, spreading at flowering-time; glumes thin acute, keeled, those of the perfect flower awnless, those of the neutral flowers awned.

A small grass introduced from the Old World and cultivated mainly as a lawn grass, usually in connection with other species. In some parts of the Eastern United States it is sometimes found in meadows. It is very fragrant when drying and gives a pleasant odor to hay. It yields too lightly to pay for cultivation. It is not a success in this state. The specimens analyzed were grown on the Station grounds and were cut on the 8th of August, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.82	——
Ash	10.41	11.29
Ether Extract	6.19	6.72
Crude Fibre	19.97	21.66
Crude Protein	16.62	18.03
N.-free Extract	38.99	42.30
Total Nitrogen	2.66	2.88
Albuminoid Nitrogen	2.24	2.43

REED CANARY GRASS.

(*Phalaris arundinacea* L.)

Stems, stout, erect, two to five feet high, smooth, from strong, creeping root stalks, leafy; leaves large (six to ten inches long by about half an inch in width), flat, roughish or smooth, sheaths smooth; panicle narrow, its branches short and appressed or somewhat spreading at flowering time, three to five inches long; spikelets numerous, crowded, about one-sixth of an inch long, more or less tinged with purple; empty glumes equal, spreading at flowering, much longer than the flowering glume, rough on the back but not wing-keeled; flowering glume smooth and shining, with two minute, hairy scales at its base, in fruit closely enclosing the smooth grain. Plate 12.

Widely distributed over the state, growing naturally in wet ground. It is one of the most important of our native species as it promises to do well under cultivation. In low meadows it often constitutes a large part of the hay. Stock eat it readily. On the Station grounds it has done well for three years, withstanding severe drouth even on high ground. It produces a coarse quality of hay and seeds plentifully. The leaves remain green until after the seeds are ripe so that after cutting with a header a good yield of hay of a fair quality may be obtained. The specimens analyzed were cut on the college farm June 20th, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.37	——
Ash	8.42	9.19
Ether Extract	2.12	2.31
Crude Fibre	30.85	33.67
Crude Protein	7.59	8.28
N.-free Extract	42.65	46.55
Total Nitrogen	1.21	1.32
Albuminoid Nitrogen	.86	.94

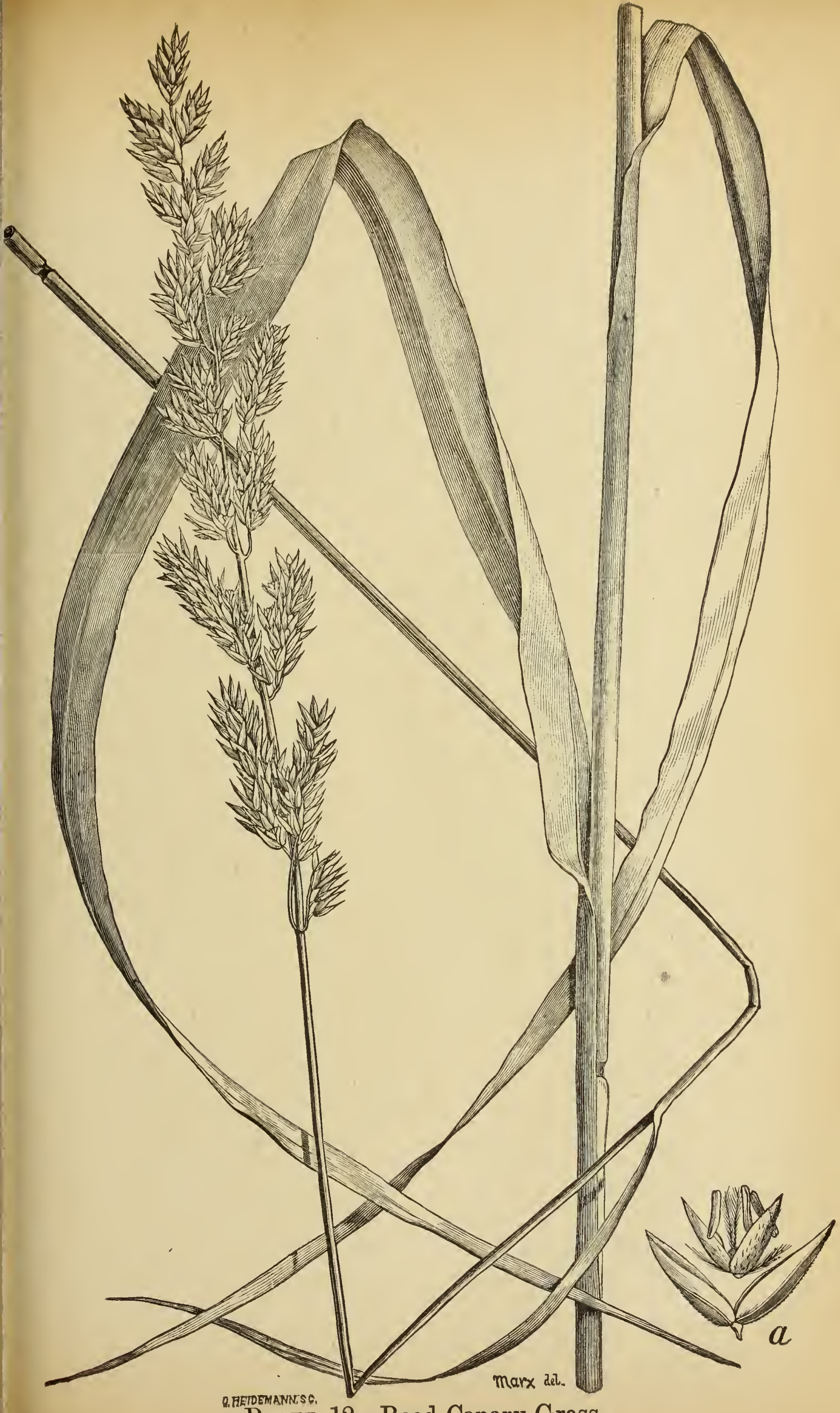
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PLATE 12—Reed Canary Grass.

PURPLE BEARD GRASS.

(*Aristida purpurea* Nutt.)

Stems slender, tufted, erect, tough and wiry, about one foot high, from perennial, fibrous roots; leaves involute, with roughened sheaths,.which are hairy at the throats and are longer than the internodes of the stem; spikelets panicled, purplish, one-flowered; lower empty glume about half as long as the upper one which is usually an inch in length, both short awned; flowering glume rolled around the flower, sharp-pointed below, the three rough awns at its apex nearly equal and from one to two inches long. Plate 13.

Very common throughout the drier portions of the state. It may be recognized by its triple-awned flowering glume, tufted habit of growth and tough, wiry stems. It often goes by the name of "bunch grass" or "wire grass." It is nearly worthless as a forage plant for it becomes tough and woody too early in the season. In most localities it is regarded as a weed. When in large tufts the tough woody stems are very difficult to cut with the mower and if much of this grass occurs in a hay field it is practically impossible to keep an edge on the sickle for any length of time. In some instances it has been of some value for early pasturage. The specimens analyzed were collected along the high lands near the Missouri river in the latter part of August. A more robust form (var. *hookeri* Trin.) occurs in the western part of the state.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	5.97	——
Ash	10.34	11.00
Ether Extract	1.73	1.84
Crude Fibre	34.66	36.86
Crude Protein	4.11	4.37
N.-free Extract	43.19	45.93
Total Nitrogen	.66	.70
Albuminoid Nitrogen	.60	.64

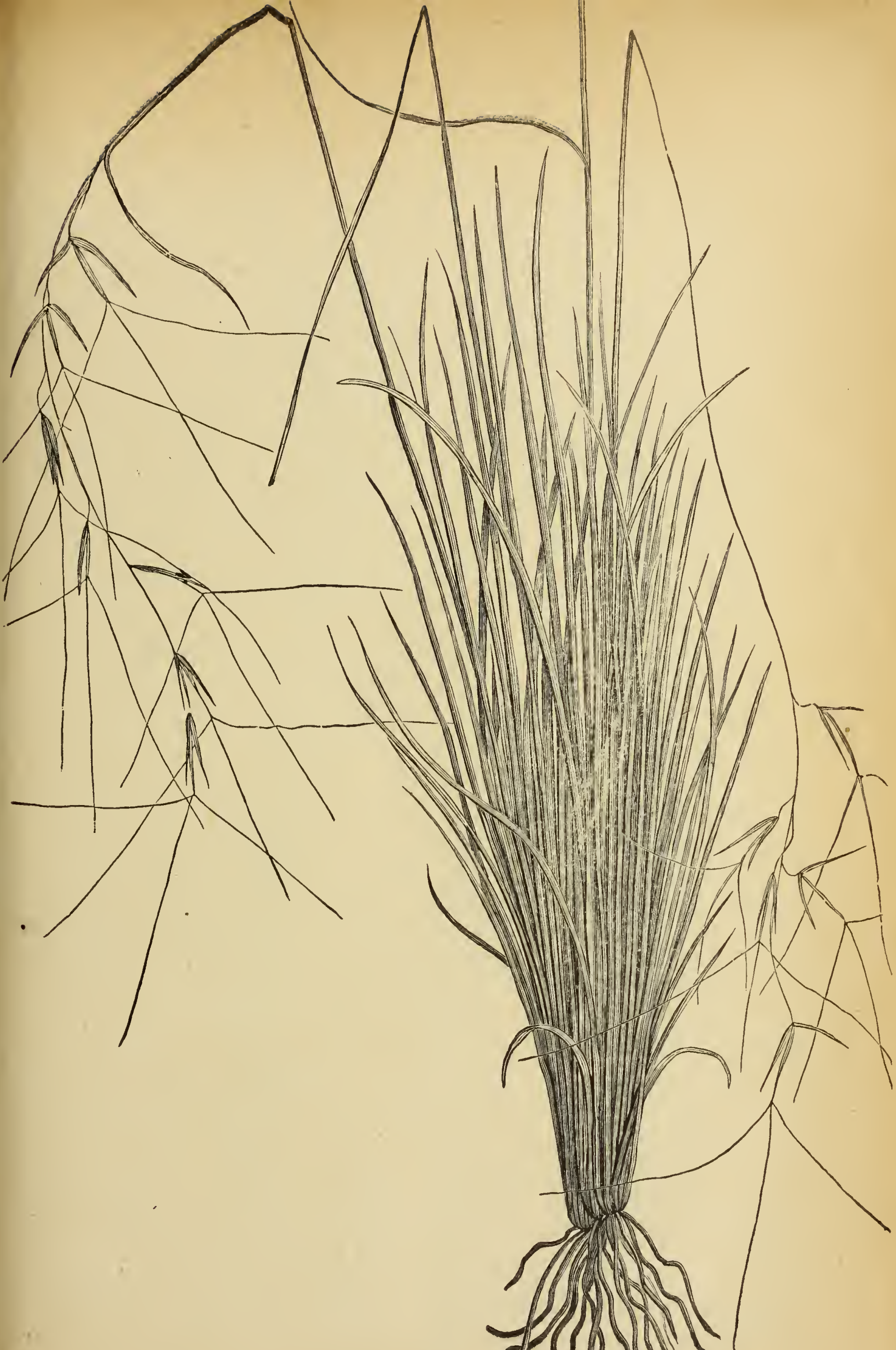

PLATE 13—Purple Beard Grass.

FEATHER BUNCH GRASS.

(*Stipa viridula* Trin.)

Stems clustered together in rather large bunches, erect, or ascending, one and one-half to four feet high, with numerous dead sheaths at the base, from tough perennial, fibrous roots; leaves flattish or becoming involute, from one to two feet in length, smoothish with roughened margins; panicle rather narrow and loose, from six inches to a foot or more long, greenish or sometimes with a purplish tinge; spikelets a quarter of an inch or more long; empty glumes rather thin and papery, bristle-pointed; flowering glume rolled around the flower, with a short, hard point below and a roughish, flexuous awn an inch to an inch and a half long above, hairy, especially at the ends. Plate 14.

This grass is more or less common in all parts of the state. It is quite variable, several varieties being found within our limits. It is a good pasture grass when kept closely grazed and is not as liable to injure stock as either of the other species found in the state. As a rule it does not give as great a yield of hay as those species because of its generally lighter growth of root leaves. It prefers rather dry soils. The specimen analyzed were cut July 2, 1891, at Brookings.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	9.10	——
Ash	6.43	7.07
Ether Extract	2.16	2.38
Crude Fibre	32.12	35.34
Crude Protein	6.87	7.56
N.-free Extract	43.32	47.66
Total Nitrogen	1.10	1.21
Albuminoid Nitrogen	.90	.99

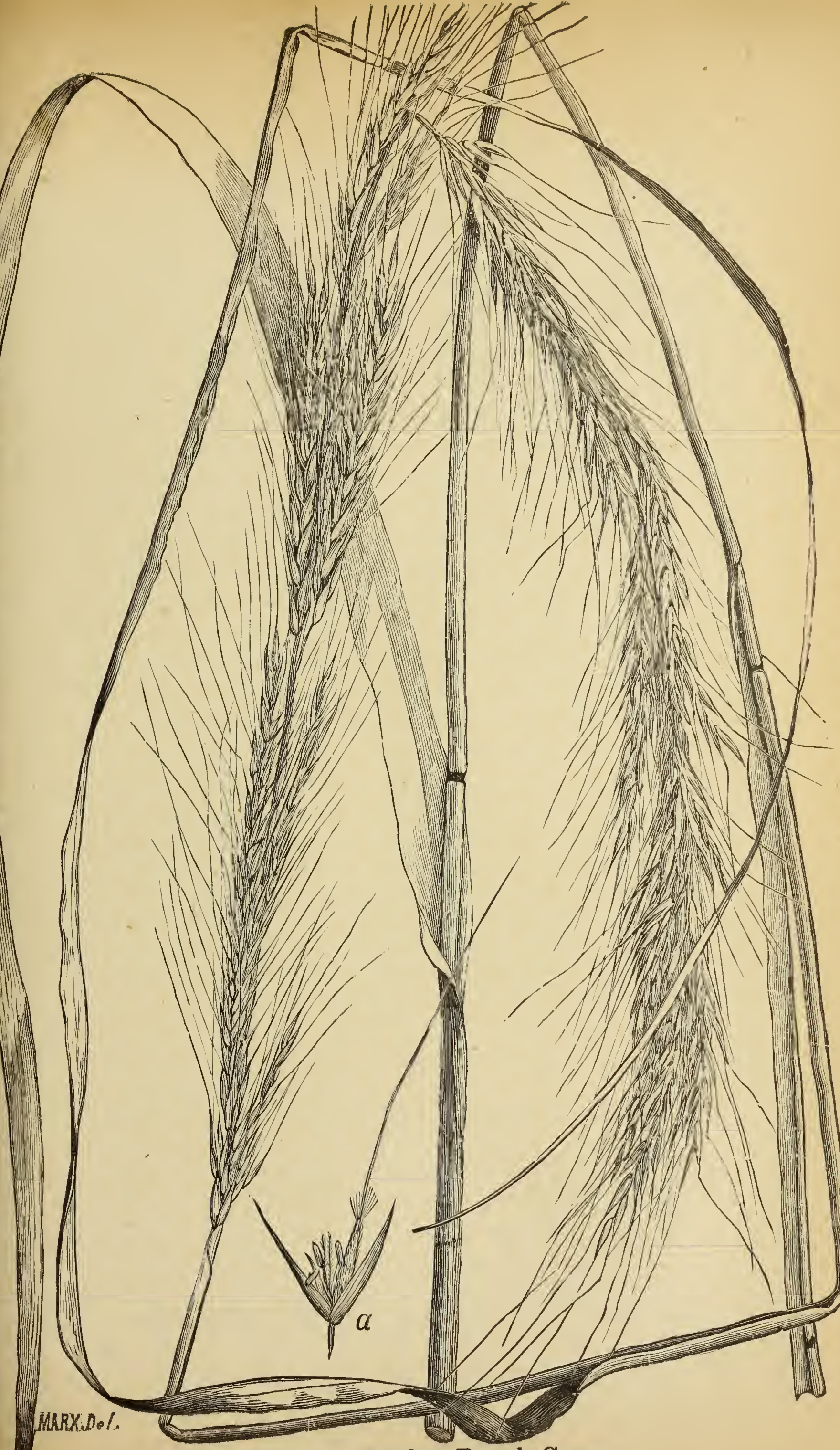

PLATE 14—Feather Bunch Grass.

PORCUPINE GRASS.

(*Stipa spartea* Trin.)

Stems stout, erect, smooth, more or less bunched, one and one-half to three feet high, from tough perennial roots; leaves more or less involute, thick and hard, rough on the margins, usually a foot or two long, root-leaves numerous and long; panicle about six inches long, contracted; spikelets an inch or more long, borne at the ends of the slender branches of the panicle; empty glumes lanceolate, with long awn-like points, greenish, one to one and one-half inches in length, the upper one longest; flowering glume, very hard and sharp-pointed at maturity, thickly hairy above the point; awn rough, stiff, four to six inches long, twisted and bent. Plate 15.

This grass is found throughout the state but is most common in the eastern part. It is largely replaced in the western part of the state by needle grass (*Stipa comata*) which may be distinguished from either porcupine grass or feather bunch grass by its shorter leaves and loose, open panicle, the lower part of which is more or less included in the uppermost sheath. Both porcupine grass and needle grass give good yields of hay of a fair quality. As the spear like fruits of these grasses some times injure stock, they should not be cut until after the fruits have fallen, which usually occurs in time for haying. When these grasses occur in pastures or ranges in sufficient quantities to be dangerous, they should be kept from going to seed by close grazing or by mowing. Late burning will be found useful in keeping them down and also in keeping many early growing weeds in check. The specimens analyzed were cut at Brookings on the 30th of June, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	9.93	——
Ash	5.43	6.03
Ether Extract	2.34	2.60
Crude Fibre	31.92	35.44
Crude Protein	7.57	8.40
N.-free Extract	42.81	47.53
Total Nitrogen	1.21	1.34
Albuminoid Nitrogen	1.01	1.13

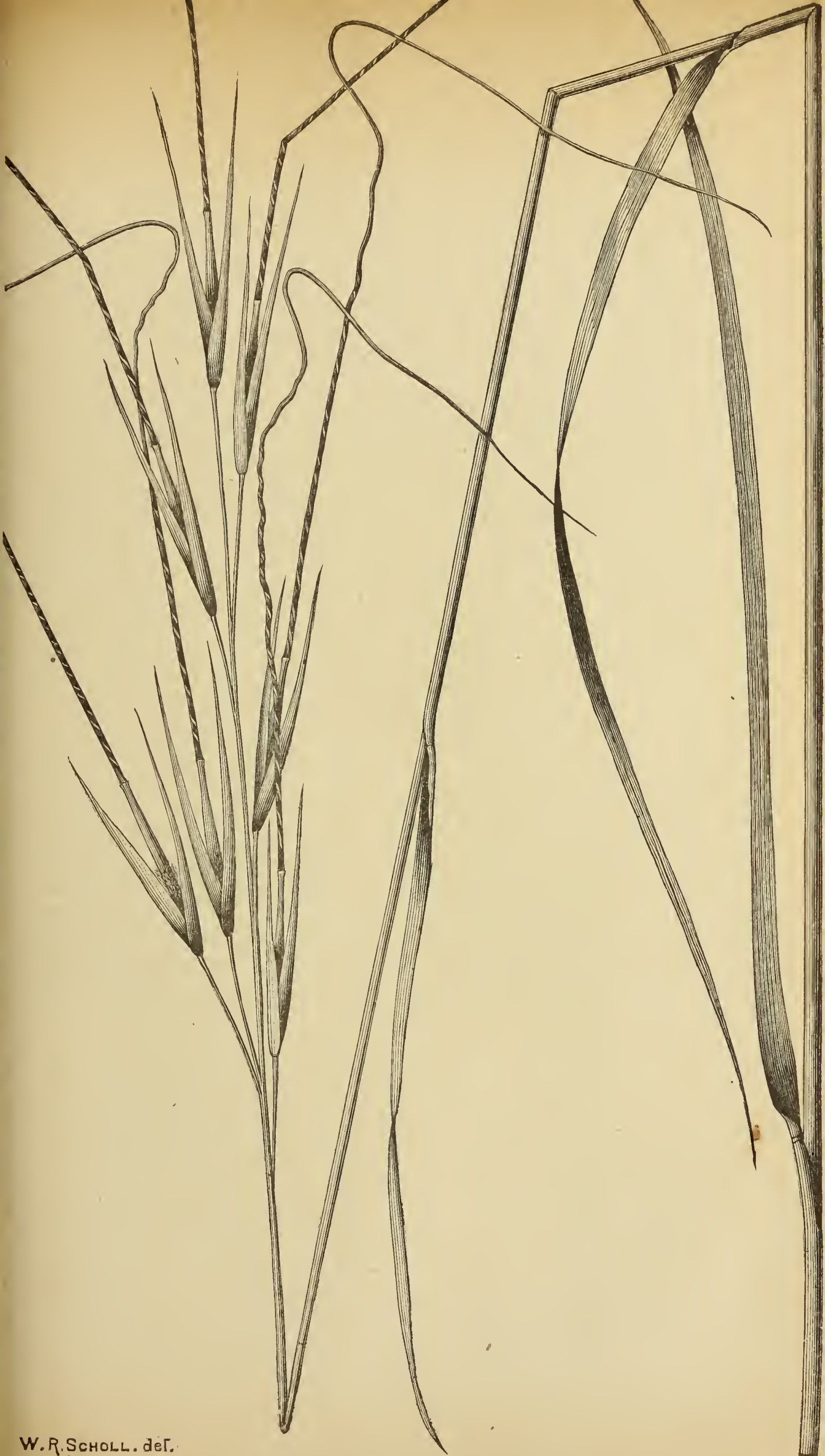
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PLATE 15—Porcupine Grass.

SPIKED MUHLENBERG'S GRASS.

(*Muhlenbergia racemosa* (Michx.) B. S. P.)

Stems upright, two to three feet high, stiff, more or less branched, from perennial roots and hard, knotty, creeping rootstocks, very leafy; leaves narrow, rough, one to six inches long; panicle two to four inches long, narrow, composed of numerous, close sessile clusters of flowers, looser below, forming an interrupted false spike; spikelets sessile, numerous small; empty glumes awn-pointed, nearly equal, much longer than the very acute flowering glume. Plate 16.

This is a very common grass throughout the greater part of the state. It is quite valuable as a forage plant. It gives a good yield of hay of a fair quality. To obtain the best results it should not be allowed to stand too long as the stems become hard and woody. In Nebraska and Colorado as well as in many parts of the East this grass is very highly spoken of. Small plats of it cultivated on the Station grounds are doing well. It seems worthy of more attention. The specimens analyzed were cut on the college grounds on the 27th of July, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	4.85	——
Ash	7.62	8.01
Ether Extract	1.99	2.09
Crude Fibre	35.35	37.15
Crude Protein	5.04	5.30
N.-free Extract	45.15	47.45
Total Nitrogren	.81	.85
Albuminoid Nitrogen	.73	.77

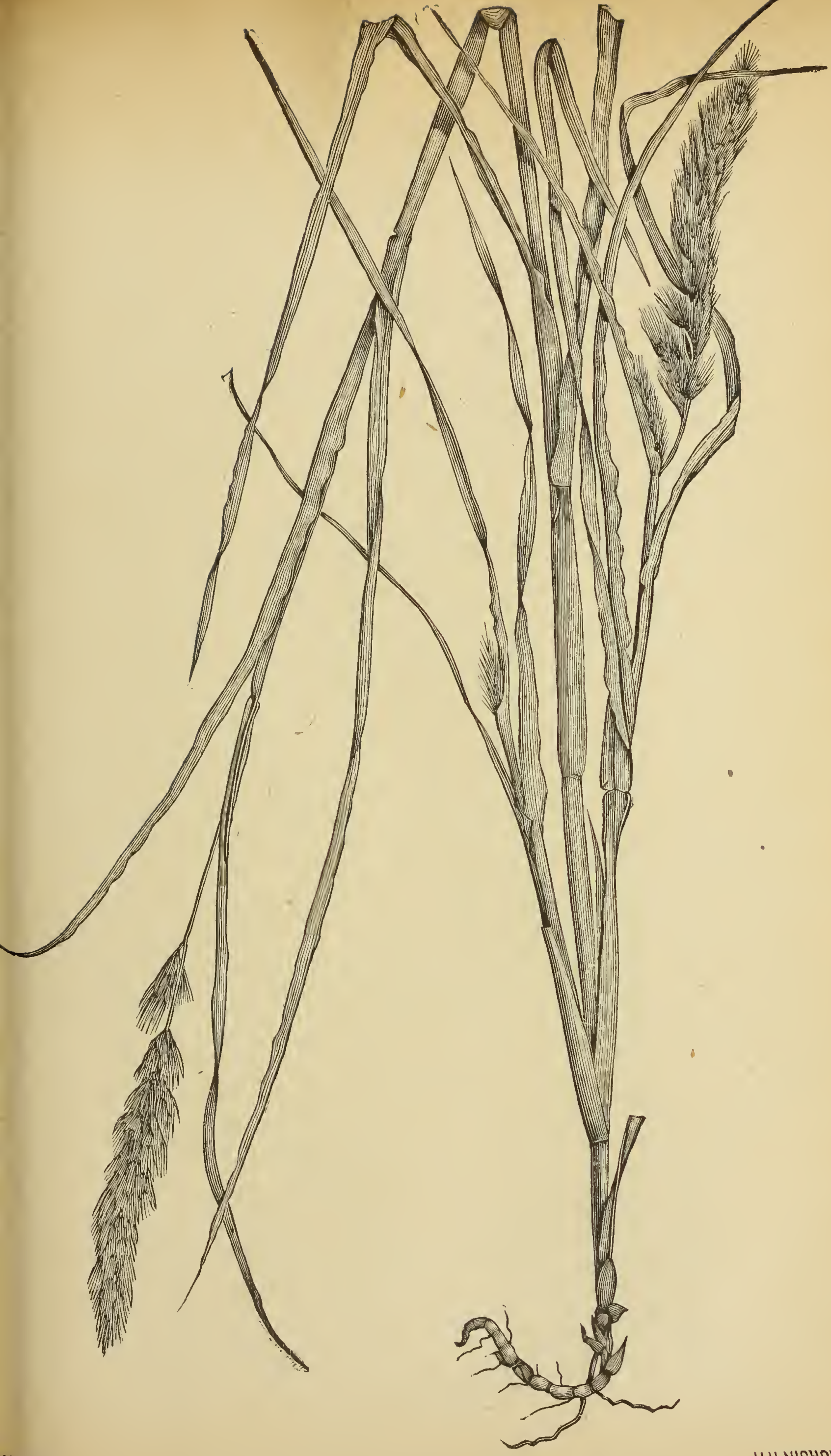
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Plate 16—Spiked Muhlenberg's Grass.

MEXICAN WOOD GRASS.

(*Muhlenbergia mexicana* (L.) Trin.)

Stems erect, or spreading and ascending, much branched, two to three and one-half feet high, from rather short, scaly, creeping, root-stocks; perennial; leaves rather short and narrow, rough; panicles both terminal and lateral, narrow, two to six inches long, greenish or purplish; spikelets numerous, thickly clustered on the branches of the panicle, about one-tenth of an inch long; empty glumes sharp-pointed but awnless, unequal, the upper one about the length of the very acute flowering glume. Plate 17.

Not uncommon in the eastern part of the state where it grows chiefly in moist, shaded places. It is of no very great importance as a forage plant and is not worthy of cultivation. It does not thrive in dry soils. The specimens analyzed were collected at Sioux Falls on the 1st of September, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.31	——
Ash	9.67	10.43
Ether Extract	2.49	2.69
Crude Fibre	27.96	30.17
Crude Protein	13.05	14.08
N.-free Extract	39.52	42.64
Total Nitrogen	2.09	2.25
Albuminoid Nitrogen	1.35	1.45

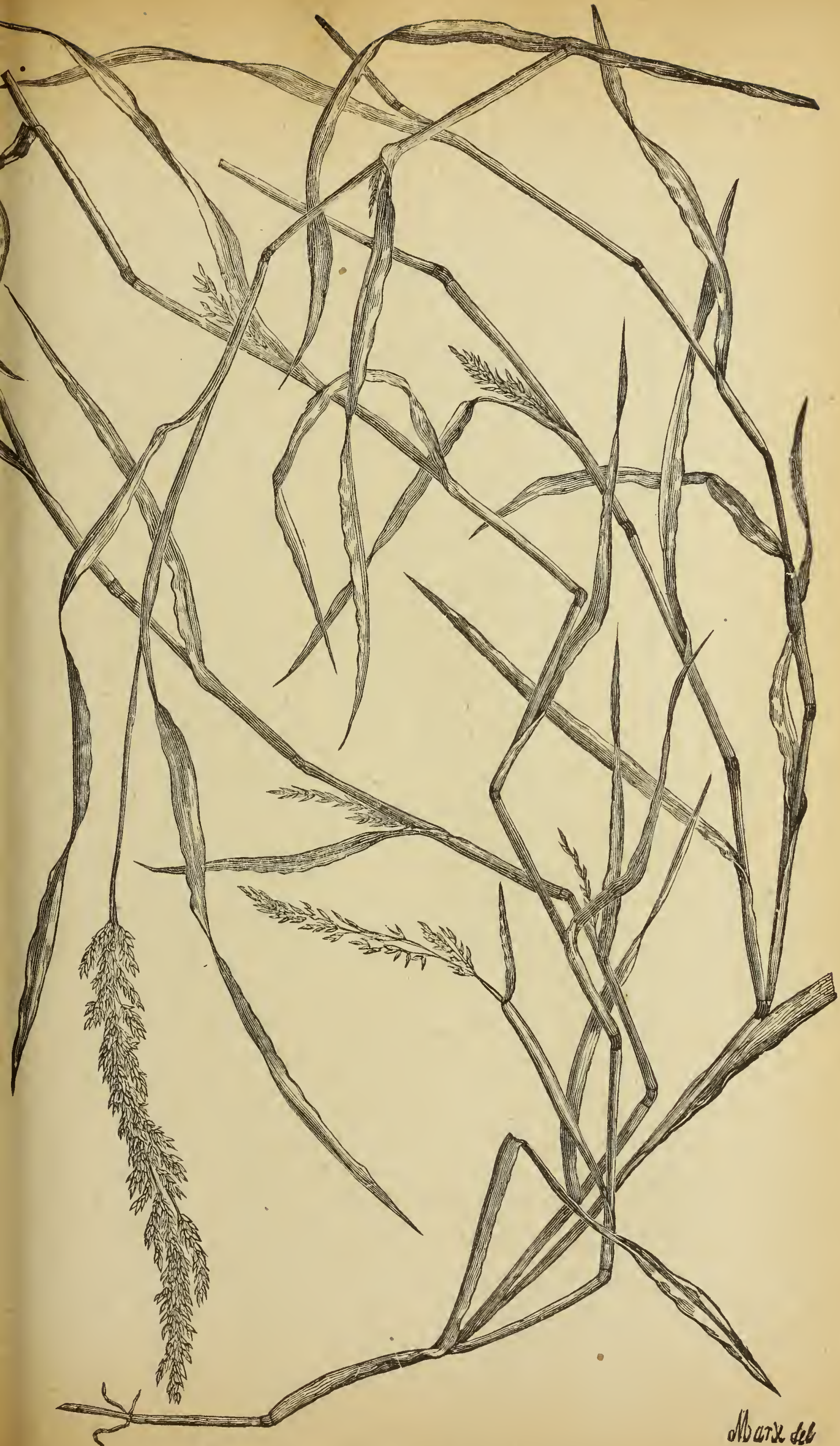


PLATE 17—Mexican Wood Grass.

WOOD GRASS.

(*Muhlenbergia sylvatica* Torr. & Gray.)

Stems rather slender, ascending, branched, diffusely spreading, two to four feet high, leafy, from scaly, creeping rootstocks; perennial; leaves two to six inches long, flat, rather broader than in either of the other species, roughish; panicle narrow, spike-like, looser and not so densely flowered as in the preceding species; empty glumes nearly equal, bristle-pointed; flowering glume longer than the empty glumes, with an awn two or three times its own length. Plate 18.

This, like the preceding species, occurs only in the eastern part of the state. It prefers dry, open wood-lands. It affords a limited amount of forage but is of little value agriculturally. The specimens analyzed were collected at Big Stone on the 26th of August, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.86	——
Ash	8.71	9.35
Ether Extract	2.28	2.45
Crude Fibre	33.41	35.87
Crude Protein	8.63	9.27
N.-free Extract	40.11	43.06
Total Nitrogen	1.38	1.48
Albuminoid Nitrogen	1.16	1.24

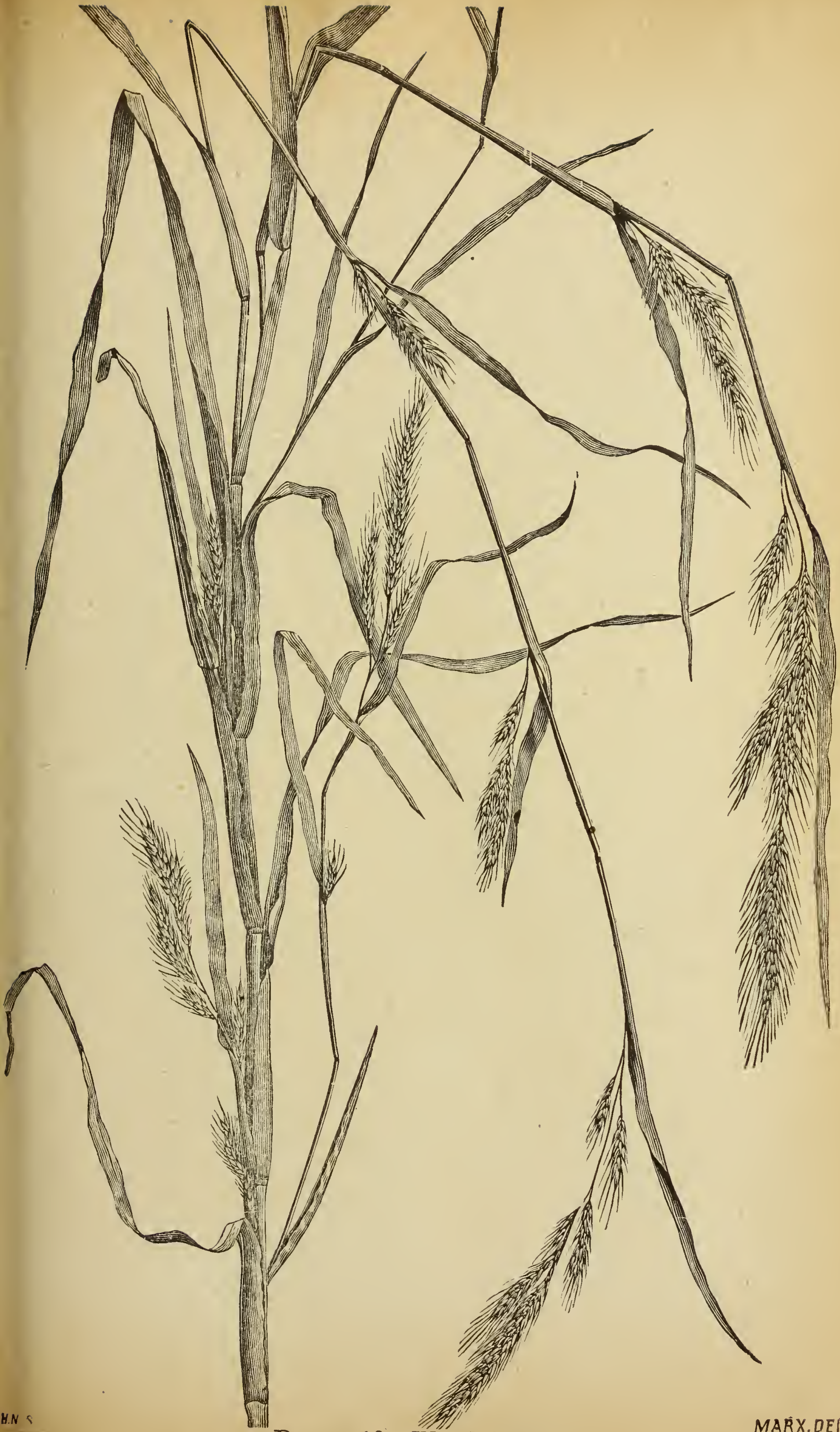


PLATE 18—Wood Grass.

TIMOTHY.

(*Phleum pratense* L.)

Stems erect, simple, tufted, one and one-half to four feet high, often bulbous at the base, rough; roots fibrous, perennial; leaves four or five on each stem, short above and longer below, flat, rough; spike cylindrical, usually from two to six inches long; empty glumes with a fringe of hair on the back, tipped with a short bristle. Plate 19.

This is one of the best known hay grasses in the United States. It is a native of Europe and probably also of America and has been cultivated in the United States nearly one hundred and fifty years. Throughout the northern and western states it is considered the best grass that can be raised for hay. It does best on moist, loamy soil. Throughout the Sioux Valley region timothy is a paying crop if properly handled. In some parts of the Black Hills region it does well. Wherever irrigation is possible there will be no difficulty in making this grass pay well unless the soil is too light and sandy. Timothy does not root deeply enough to obtain much nourishment from the sub-soil and hence exhausts the soil. To overcome this difficulty the timothy field should be given a good top-dressing of well rotted manure in the fall or early winter. If the soil becomes "baked" a light harrowing should follow the application of the manure. The harrowing should be done in early spring. On the grounds of the Experiment Station timothy and alsike are doing well sown together. Good crops of timothy and of timothy and clover have been grown in various parts of the Sioux Valley for several years past. The specimens analyzed were cut on the college farm the middle of July, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	10.39	——
Ash	6.62	7.39
Fther Extract	3.21	3.58
Crude Fibre	30.82	34.39
Crude Protein	7.92	8.84
N.-free Extract	41.04	45.80
Total Nitrogen	1.27	1.42
Albuminoid Nitrogen	1.02	1.14

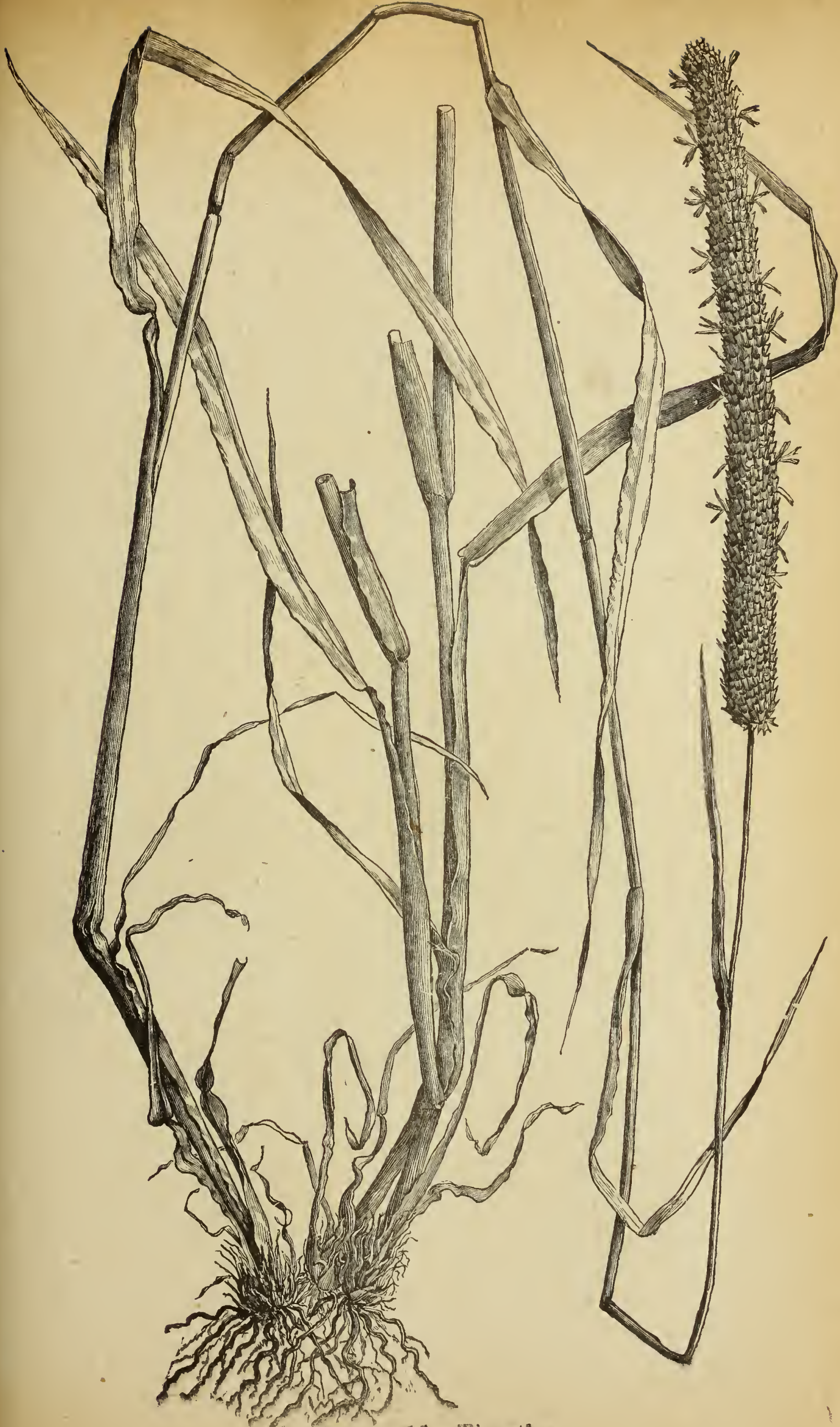


PLATE 19—Timothy.

MEADOW FOX-TAIL.

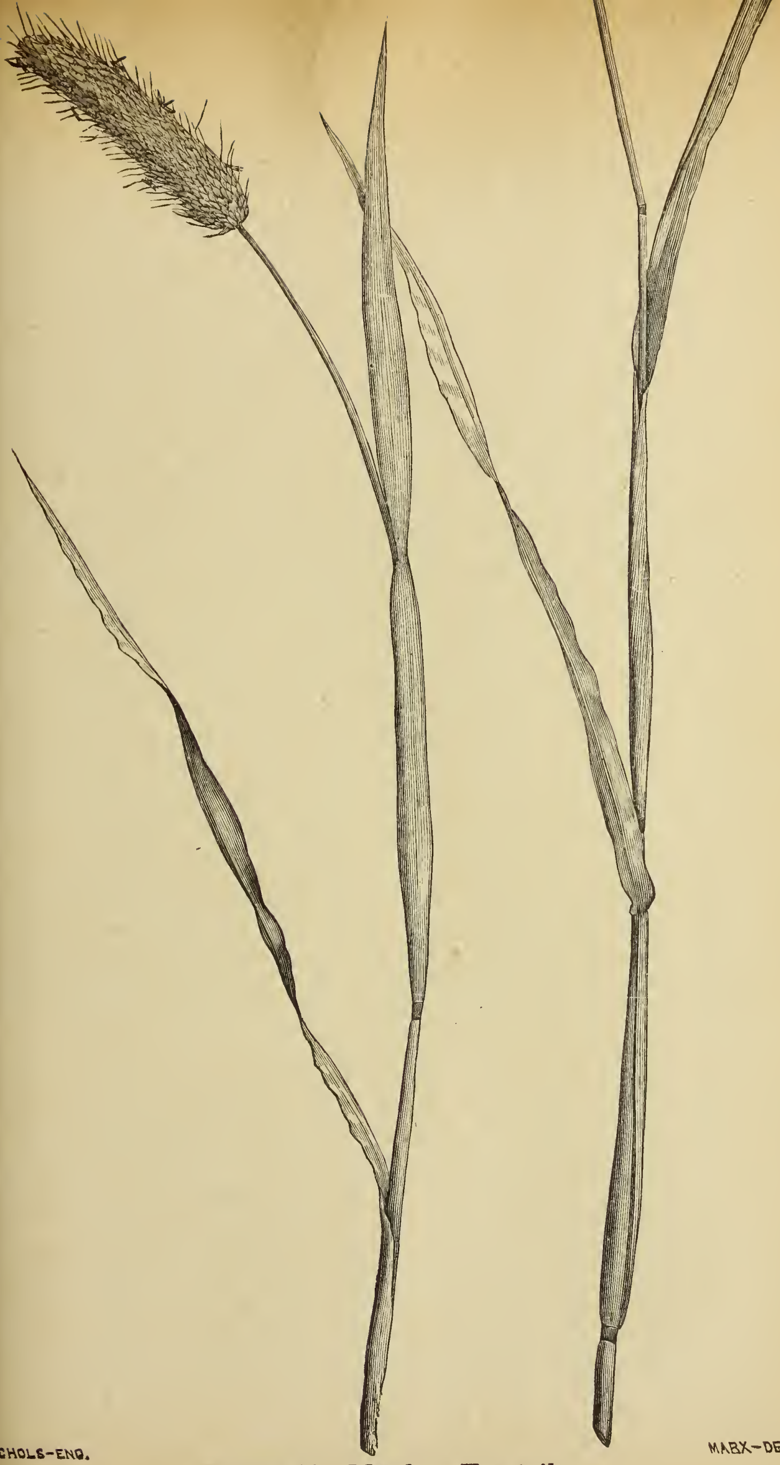
(*Alopecurus pratensis* L.)

Stems erect, smooth, tufted, unbranched, one and one-half to two and one-half feet high, from tough, perennial fibrous roots; leaves four or five on a stem, two to four inches long, rather broad and flat, tapering gradually to a sharp point, roughish, smooth on the sheaths, which are often swollen; spike cylindrical, densely flowered, soft, the awns of the flowers conspicuously projecting, one and one-half to three inches long; spikelets one-flowered, about one-fifth of an inch long; empty glumes nearly equal, strongly compressed, boat-shaped, very hairy on the keels; flowering glume folded upon itself, enclosing the flower, with the slender awn proceeding from its back near the base. Plate 20.

This is native of the Old World and bears some resemblance to timothy. It is thought to be a very valuable grass in the East. Like timothy it prefers a rich, moist loam. It comes up much earlier in the spring than that grass, however, and will endure close grazing without being killed out. It is not so good for a hay crop, but produces a much more luxuriant aftermath. Stock eat it very greedily either in pasture or as dry forage. The hay is not so heavy in proportion to the bulk as is that of timothy. On the Station grounds it has proven a valuable grass. It is an excellent plant to raise under irrigation. It is not easily affected by the hot sun and will stand frequent or close mowings much better than timothy. On this account it is often used as a lawn grass. The specimens analyzed were cut the 1st of June, 1892, on the grounds of the Experiment Station.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.62	——
Ash	9.84	10.54
Ether Extract	3.09	3.31
Crude Fibre	32.27	34.56
Crude Protein	9.25	9.91
N.-free Extract	38.93	41.69
Total Nitrogen	1.48	1.58
Albuminoid Nitrogen	1.36	1.45



H.NICHOLS-ENG.

PLATE 20—Meadow Fox-tail.

WILD WATER FOX-TAIL.

(*Alopecurus geniculatus aristulatus* (Michx.) Torr.)

Stems usually bent at the lower joints and ascending, but some times nearly upright, tufted, smooth, often branching, usually from eight to eighteen inches high, from perennial, fibrous roots; leaves glaucous, about three or four on a stem, two to four inches long, flat, taper-pointed, smoothish or roughened, the sheaths smooth and usually somewhat swollen; spike cylindrical, from one and one-half to two inches long, or rarely longer, densely flowered, slenderer than in the preceding species; empty glumes obtuse, rather shorter than the flowering glume, the latter usually with a short awn.

A native grass more or less common throughout the state in low, wet places or in shallow water. It is of no value for cultivation. Along low, wet margins of ditches, ponds and sloughs it sometimes furnishes a small amount of pasturage. The specimens analyzed were collected at Brookings in the college pastures on the 10th of July, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.80	——
Ash	11.11	12.05
Ether Extract	3.23	3.50
Crude Fibre	25.18	27.31
Crude Protein	8.36	9.07
N.-free Extract	44.32	48.07
Total Nitrogen	1.34	1.45
Albuminoid Nitrogen	1.33	1.44

BLACK MOUNTAIN RICE.

(*Oryzopsis melanocarpa* Muhl.)

Stems upright, rough, two to three feet high, leafy; roots perennial; leaves broad and flat, eight to twelve inches long, with a long tapering point, rough, the sheaths hairy at the throat; panicle narrow, simple or sparingly branched, usually about six to eight inches long; spikelets about three-eighths of an inch long; empty glumes green, equal, longer than the flowering glumes, lower one 7-9 nerved, the upper one 5-nerved; flowering glume enclosing the seed at maturity, blackish, with an awn about an inch long.

This grass has been found in but two places in the state—at Big Stone and in the northeastern part of Brookings county. It grows in dry woods and is probably of little value as a forage plant. The specimens analyzed were collected September 1st, 1892, in Brookings county.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.19	——
Ash	10.33	11.01
Ether Extract	1.95	2.08
Crude Fibre	31.61	33.70
Crude Protein	8.53	9.09
N.-Free Extract	41.39	44.12
Total Nitrogen	1.36	1.45
Albuminoid Nitrogen	1.18	1.25

INDIAN MILLET.

(*Oryzopsis micrantha* (Trin. & Rupr.) Thurb.)

Stems slender, erect, tufted, one and one-half to two feet high, from tough perennial roots; leaves numerous, rough, hard, slender, involute, with very long, sharp points; panicle two to six inches long, the slender spreading branches naked below and many-flowered at the upper ends; spikelets shining, about one-eighth of an inch long; flowering glume smooth, shorter than the empty glumes, enclosing the grain in fruit, with a slender, deciduous awn about three times its own length.

This grass is quite common in central and western South Dakota. Wherever it is found in any quantity it is considered to be of great value. There is another kind of "Indian millet," or "bunch grass" (*Oryzopsis cuspidata*) which has a distribution similar to that of this species. In the Bad Lands and along the Cheyenne river it is thought to be quite valuable. This is the grass illustrated in Plate 21.

It may be distinguished from the first named species by its very large wide-spreading panicle, large hairy fruit, and generally coarser habit of growth. Both seem to be worthy of trial under cultivation. The specimens analyzed were collected in Potter county the 1st of September, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.06	——
Ash	15.94	16.97
Ether Extract	2.21	2.35
Crude Fibre	29.10	30.98
Crude Protein	8.06	8.58
N.-free Extract	38.63	41.12
Total Nitrogen	1.29	1.37
Albuminoid Nitrogen	.97	1.03

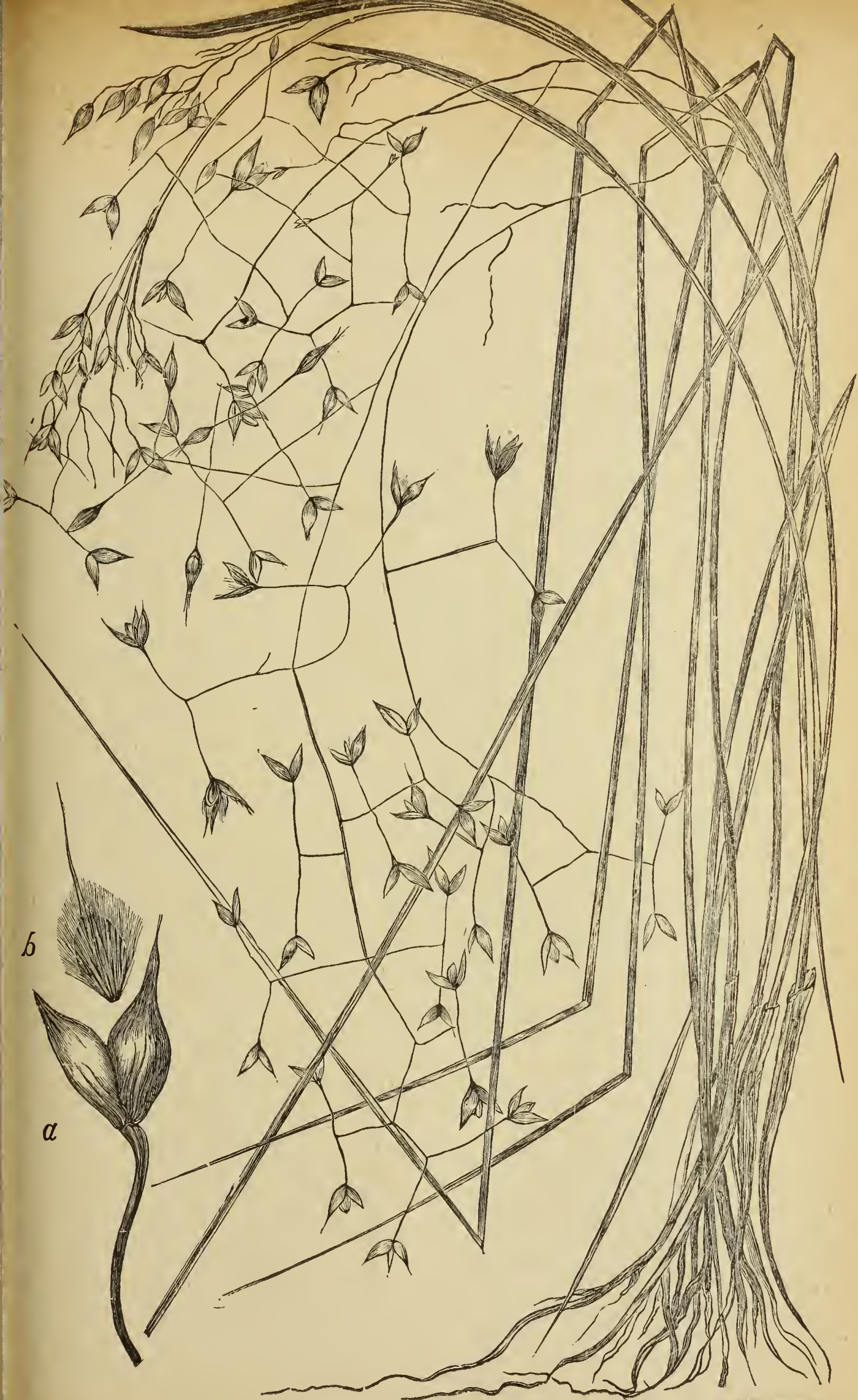


Plate 21—Indian Millet.

SOUTHERN POVERTY GRASS.

(*Sporobolus vaginaeflorus* (Torr.) Vasey.)

Stems slender, ascending, more or less bent below, branching, six to eighteen inches high, smooth, usually purplish above the sheaths, from annual, fibrous roots; leaves short (one to four inches long) involute, long-pointed; panicles simple and spike-like, lateral and terminal, often brownish or purplish, usually more or less included in the sheaths, especially those produced later in the season; spikelets one-flowered, small; empty glumes nearly equal, about as long as the flowering glume, all acute; grain brownish, oval, almost as long as the flowering glume and palet.

Widely distributed over the eastern half of the state but seldom plentiful in any one locality. It is most common in the Sioux Valley. It thrives best on rather dry soils and is found chiefly along roadsides and in waste places. The specimens analyzed were collected at Dell Rapids the 1st of September, 1892, and were then in fruit. The grass has very little agricultural value.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	5.64	——
Ash	5.50	5.83
Ether Extract	2.00	2.12
Crude Fibre	31.14	33.00
Crude Protein	9.20	9.75
N.-free Extract	46.52	49.30
Total Nitrogen	1.47	1.56
Albuminoid Nitrogen	1.18	1.25

PRAIRIE GRASS.

(*Sporobolus cuspidatus* (Torr.) Scribn.)

Stems slender and wiry, erect, branching, more or less tufted, a foot or more in height, from stout, perennial roots; leaves numerous, short, narrow and pointed, appressed to the stem; smooth; panicle exerted, simple, narrow, two to four or five inches long; spikelets smaller than in the preceding species; empty glumes very acute, shorter than the flowering glume which has a sharp, stiff point.

Widely distributed over the entire state. It thrives on a variety of soils but prefers that of the drier draws or swales. Though often occurring in pasturage or hay it possesses little value as a forage, except perhaps in parts of the state where better grasses do not thrive. The specimens analyzed were collected at Brookings on the 10th of August.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.55	——
Ash	4.78	5.23
Ether Extract	2.12	2.32
Crude Fibre	29.02	31.73
Crude Protein	6.38	6.98
N.-free Extract	49.15	53.75
Total Nitrogen	1.02	1.12
Albuminoid Nitrogen	.95	1.04

WIRE GRASS.

(*Sporobolus heterolepis* Gray.)

Stems erect, tufted, wiry, one and one-half to three feet high, smooth, from a mass of strong, fibrous, perennial roots; leaves involute, long and slender (particularly the root leaves which often reach two feet in length), rough on the edges; panicle long stalked, spreading, three to six inches long, with yellowish, sticky, glandular spots in the axils of, or at intervals along the branches, purplish brown; spikelets about one-fifth of an inch long on slender pedicels; empty glumes sharp pointed, very unequal, the upper one longer and broader; flowering glume and palet obtuse, nearly equal, shorter than the upper empty glume.

This is one of the most valuable grasses belonging to this genus. It is found in nearly all portions of the state but is most common in the eastern and southern parts. Throughout the Sioux Valley it is an important element in the prairie meadows and pastures. Owing to its tendency to grow in bunches it is often called "bunch grass." It yields a good quality of hay. The seeds are peculiar for giving off a strong, rather disagreeable odor when bruised. The specimens analyzed were cut near White, August 17th, 1892. There are two other grasses belonging to this genus that are valuable forage plants in the drier portions of the state. These are "prairie grass" (*Sporobolus cryptandrus*) and "bunch grass" or "alkali grass" (*Sporobolus airoides*.) The latter is one of the characteristic grasses of the Bad Lands. The first species is illustrated in Plate 22.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.90	——
Ash	4.82	5.23
Ether Extract	1.65	1.79
Crude Fibre	35.11	38.12
Crude Protein	5.65	6.13
N.-free Extract	44.87	48.72
Total Nitrogen	.90	.98
Albuminoid Nitrogen	.79	.86

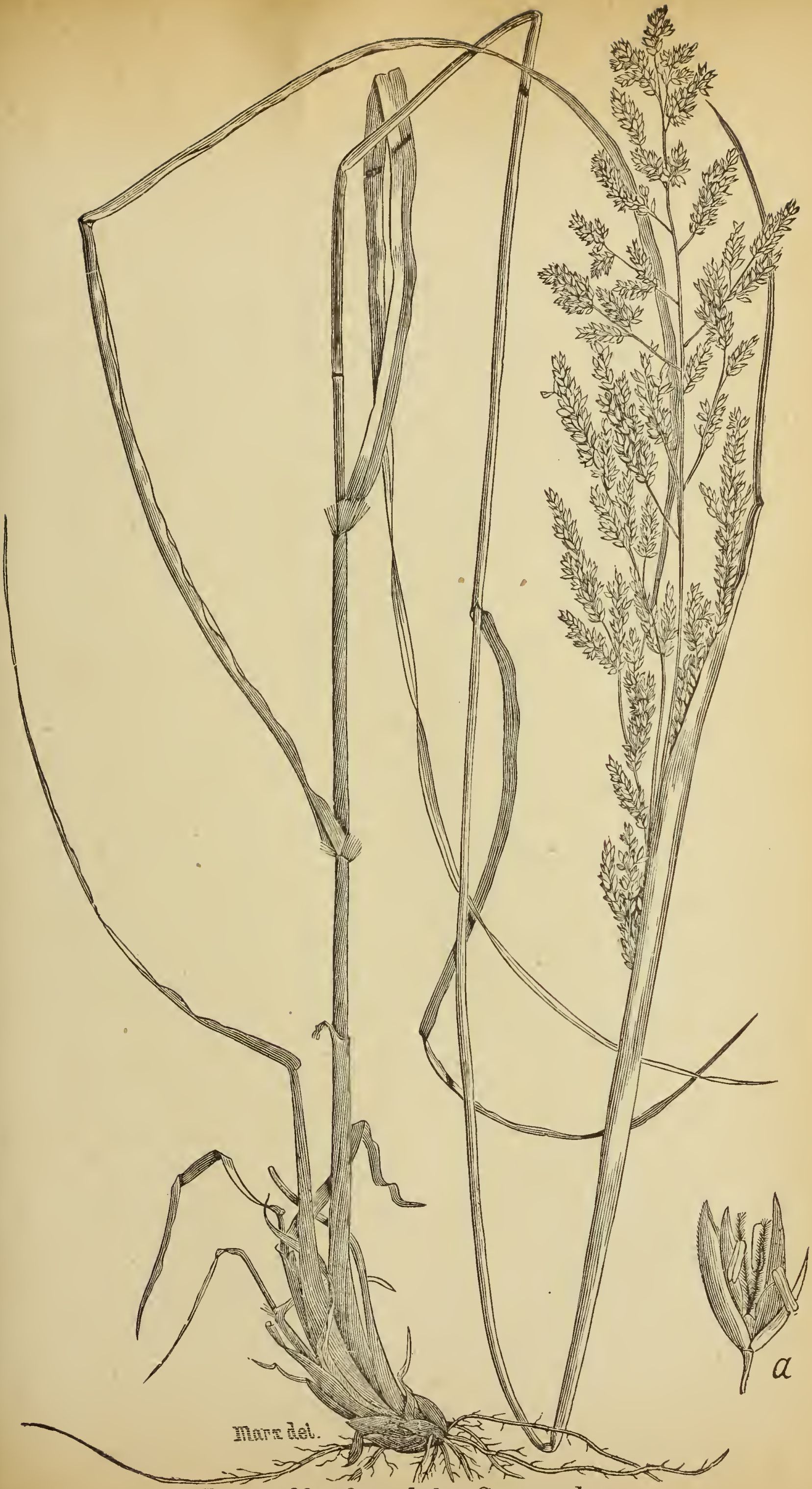


Plate 22—*Sporobolus Cryptandrus.*

ROUGH-LEAFED PRAIRIE GRASS.

(*Sporobolus asperifolius* (N. & M.) Thurb.)

Stems slender, six to sixteen inches high, profusely branching, weak and spreading, often rooting at the lower joints and forming broad, matted tufts, from perennial roots and creeping rootstocks; leaves numerous, short, (one to three inches), narrow, flat, pointed, rough, especially on the margins and upper surface; panicle usually more or less included at the base by the upper sheath, open and spreading, with fine capillary branches, three to seven inches long, and two to four inches wide, ovoid in outline; spikelets very small on long capillary pedicels; empty glumes rough, acute, nearly equal, and about as long as the flowering glume.

This is one of the characteristic grasses of the drier portions of the state. It is quite common in the Bad Lands and along the Cheyenne River. It also occurs sparingly along the divide east of the Missouri River. Although a harsh, wiry plant it furnishes a considerable amount of pasturage and when once well established it is very persistent, standing close grazing and tramping well. It may be recognized by its spreading, capillary panicles, rough leaves, and matted habit of growth. The specimens analyzed were collected in the Bad Lands on Indian Creek, August 19th, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.75	——
Ash	7.62	8.26
Ether Extract	2.49	2.71
Crude Fibre	30 85	33.44
Crude Protein	4.42	4.79
N.-free Extract	46.87	50.81
Total Nitrogen	.71	.77
Albuminoid Nitrogen	.61	.66

TICKLE GRASS.

(*Agrostis hiemalis* (Walt.) B. S. P.)

Stems very slender, erect, tufted, one to two feet high, from fibrous roots; leaves short and narrow, involute or flat; panicle purplish, six to ten inches long, at length very loose and spreading, with long, clustered, capillary divisions which are branched above the middle; spikelets small, borne at the ends of the branches; empty glumes unequal, very acute, rough on the keel; flowering glume very thin, often with a minute awn.

This is a well-known grass, more or less plentiful throughout the state and growing mostly in rather dry places. It is of very little agricultural value being generally regarded as a weed though not a bad one. Its large, finely branched panicles break away soon after the seeds mature and are blown about by the wind, sometimes becoming so plentiful as to be quite disagreeable. The specimens analyzed were collected at Brookings on the 1st of July, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	9.24	——
Ash	10.28	11.33
Ether Extract	2.81	3.10
Crude Fibre	29.28	32.26
Crude Protein	8.02	8.84
N.-free Extract	40.37	44.48
Total Nitrogen	1.28	1.41
Albuminoid Nitrogen	1.16	1.28

RED TOP.

(*Agrostis alba vulgaris* (With.) Thurb.)

Stems rather slender, erect, smooth, one to two feet high, from creeping root-stocks; perennial; leaves flat, narrow, slightly roughened, two to six inches long; panicle with spreading branches, red-purple, three to six inches long; spikelets small, numerous; flowering glume thin, three nerved, awnless or rarely with a minute awn. Plate 23.

This is an introduced grass which has considerable value as a forage plant. In the east it is thought to be one of the best grasses that can be raised for dairying purposes. While it prefers low, moist soil it is nevertheless a valuable grass on dry soils that are not too gravelly. It usually does best when sown with other grasses or with clovers. Red top, timothy and clover form an excellent combination. The species (*Agrostis alba* L.) also occurs in the state, apparently as a native. On the college farm red top has been grown for several years with fairly good success. On low, moist soil the yield is good but on high gravelly land the grass does not do so well. It is quite hardy and endures close pasturing perfectly. Its vigorous underground stems or root-stocks enable it to thrive when many other grasses would be killed by drouth. The specimens analyzed were cut on the college farm on the 30th of June, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.85	——
Ash	9.03	9.80
Ether Extract	2.39	2.59
Crude Fibre	29.19	31.68
Crude Protein	11.93	12.95
N.-free Extract	39.61	42.98
Total Nitrogen	1.91	2.07
Albuminoid Nitrogen	1.28	1.38

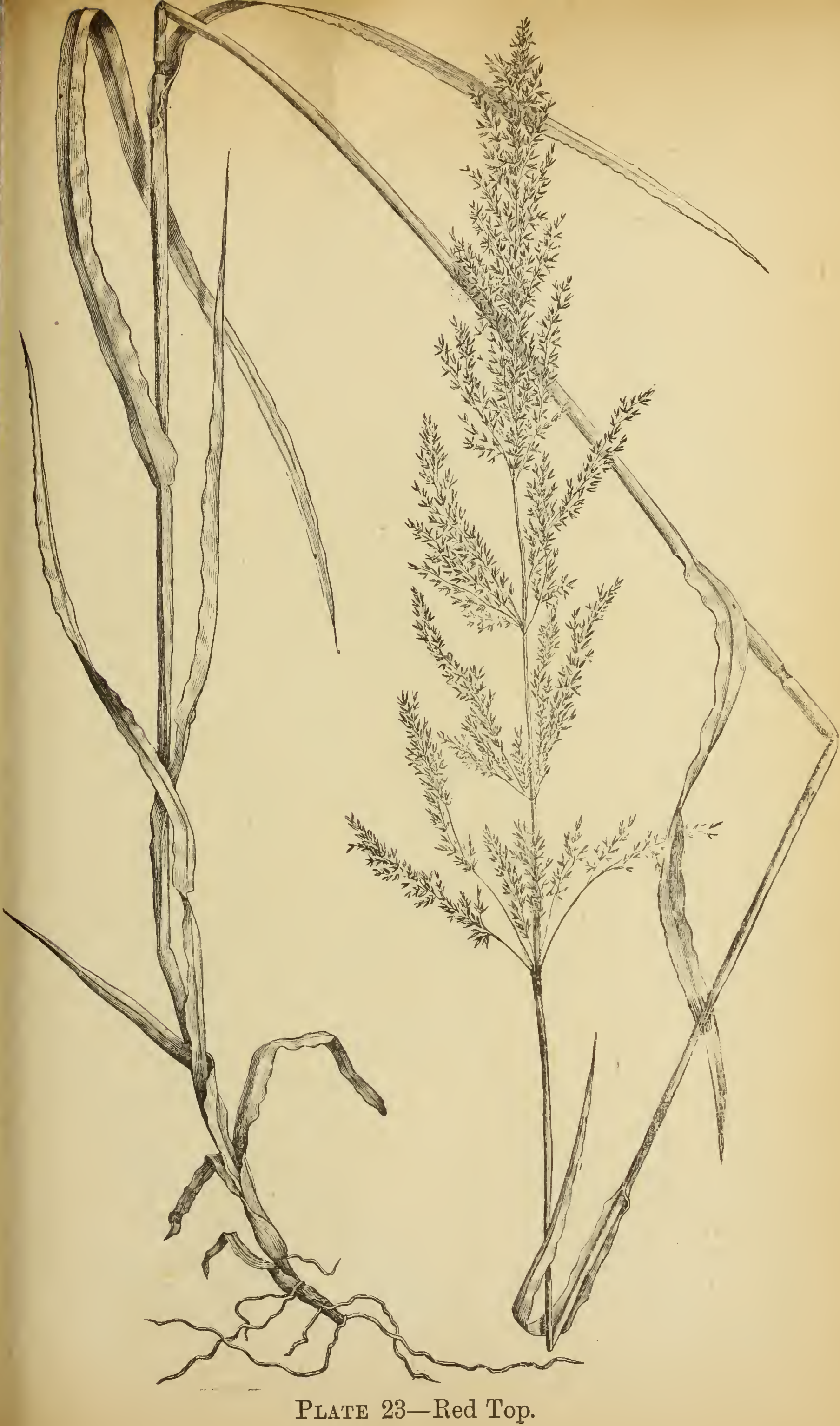


PLATE 23—Red Top.

INDIAN REED GRASS.

(*Cinna arundinacea* L.)

Stems stout, erect, smooth, three to six feet high, from perennial roots and creeping root-stocks, green, the joints brown; leaves large (about a foot long and one-fourth to one-half of an inch wide), flat, rough, the sheath smooth, ligule elongated and conspicuous; panicle large, loose and open in flower, afterwards becoming more close, six inches to a foot in length; spikelets about one-fifth of an inch long, numerous; empty glumes unequal, keeled, roughish, narrowly lanceolate, acute, green with narrow hyaline borders; flowering glume slightly exceeding the lower (shorter) empty glume, usually with a minute awn. Plate 24.

This grass has occurred, as yet, only in moist woods along the Sioux Valley. It is readily eaten by stock and gives a good quality of hay but it is too rare to be of any special agricultural value. The specimens analyzed were collected near Brookings.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.40	——
Ash	8.79	9.60
Ether Extract	3.63	3.96
Crude Fibre	26.09	28.48
Crude Protein	7.61	8.31
N.-free Extract	45.48	49.65
Total Nitrogen	1.22	1.33
Albuminoid	1.12	1.22

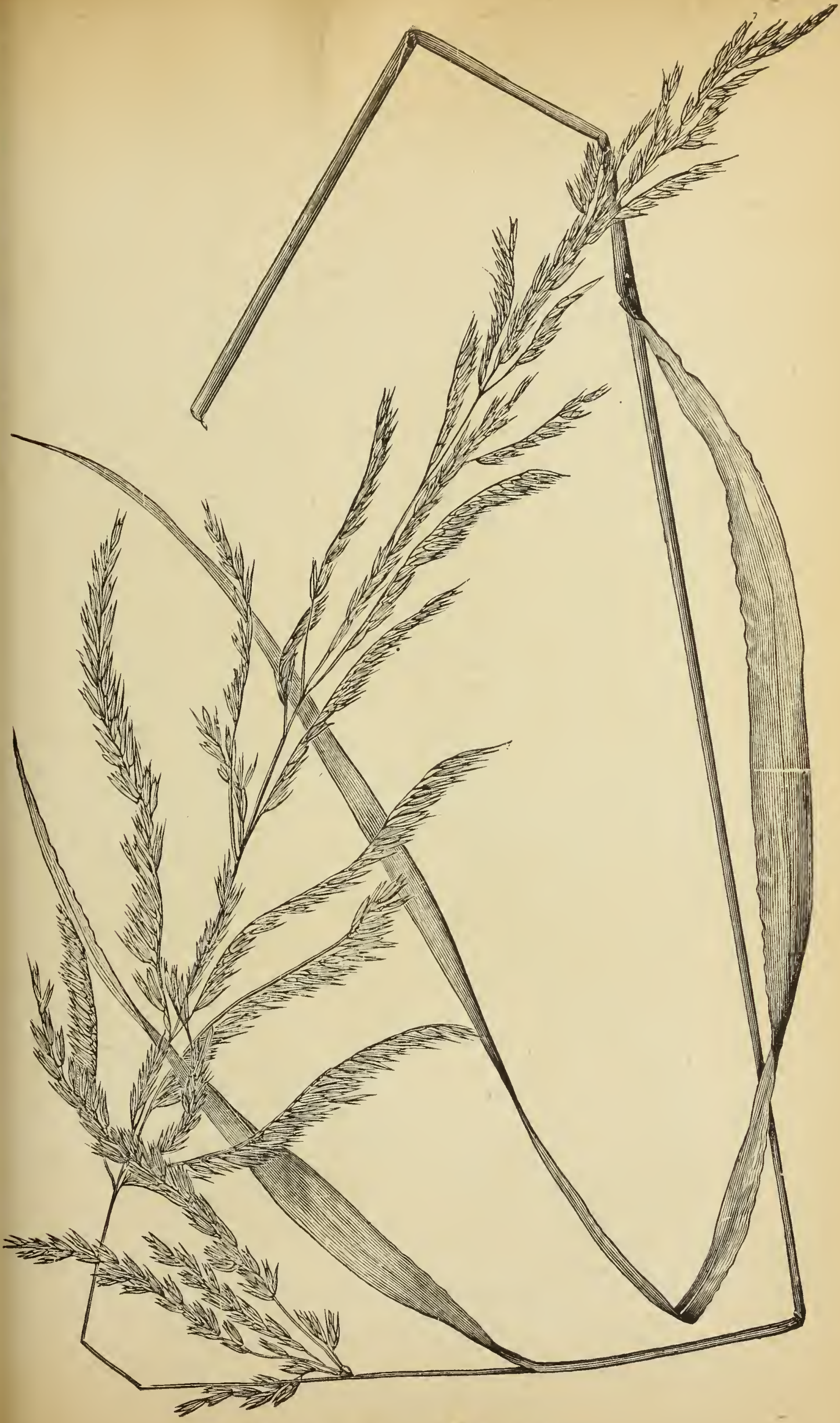


PLATE 24—Indian Reed Grass.

BLUE JOINT.

(*Calamagrostis canadensis* (Michx.) Beauv.)

Stems usually simple, erect, from perennial roots, three to five feet high, smooth; leaves large, flat, about a foot in length and from one-fourth to one-half an inch broad, roughish and glaucous; flowers arranged in loose, open panicles which are from four to eight inches long, usually purplish in color; spikelets one-tenth to one-eighth of an inch long; outer glumes lanceolate and acute; the silky white hairs at the base of the flowering glume as long as the glume itself; flowering glume thin and delicate, two-toothed at the apex, with the straight slender awn projecting from the back near the middle; palet about two thirds as long as the flowering glume. Plate 25.

A native grass growing in low, wet meadows. It may be recognized by its large size, purplish panicles, and *green* stems with *purplish joints* as contrasted with the *purplish stems* of the *blue stem grasses*. It occurs throughout the state generally but is most common in the James River Valley. A great many root leaves are produced by this grass and in favorable soils it yields large quantities of a coarse but otherwise excellent hay. In certain parts of the Northern United States and British America it is an important native grass and will bear further study as to its value under cultivation. The specimens analyzed were collected at Brookings on June 20th, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	5.51	——
Ash	6.86	7.26
Ether Extract	1.33	1.41
Crude Fibre	36.46	38.59
Crude Protein	8.74	9.25
N.-free Extract	41.10	43.50
Total Nitrogen	1.40	1.48
Albuminoid Nitrogen	1.17	1.23

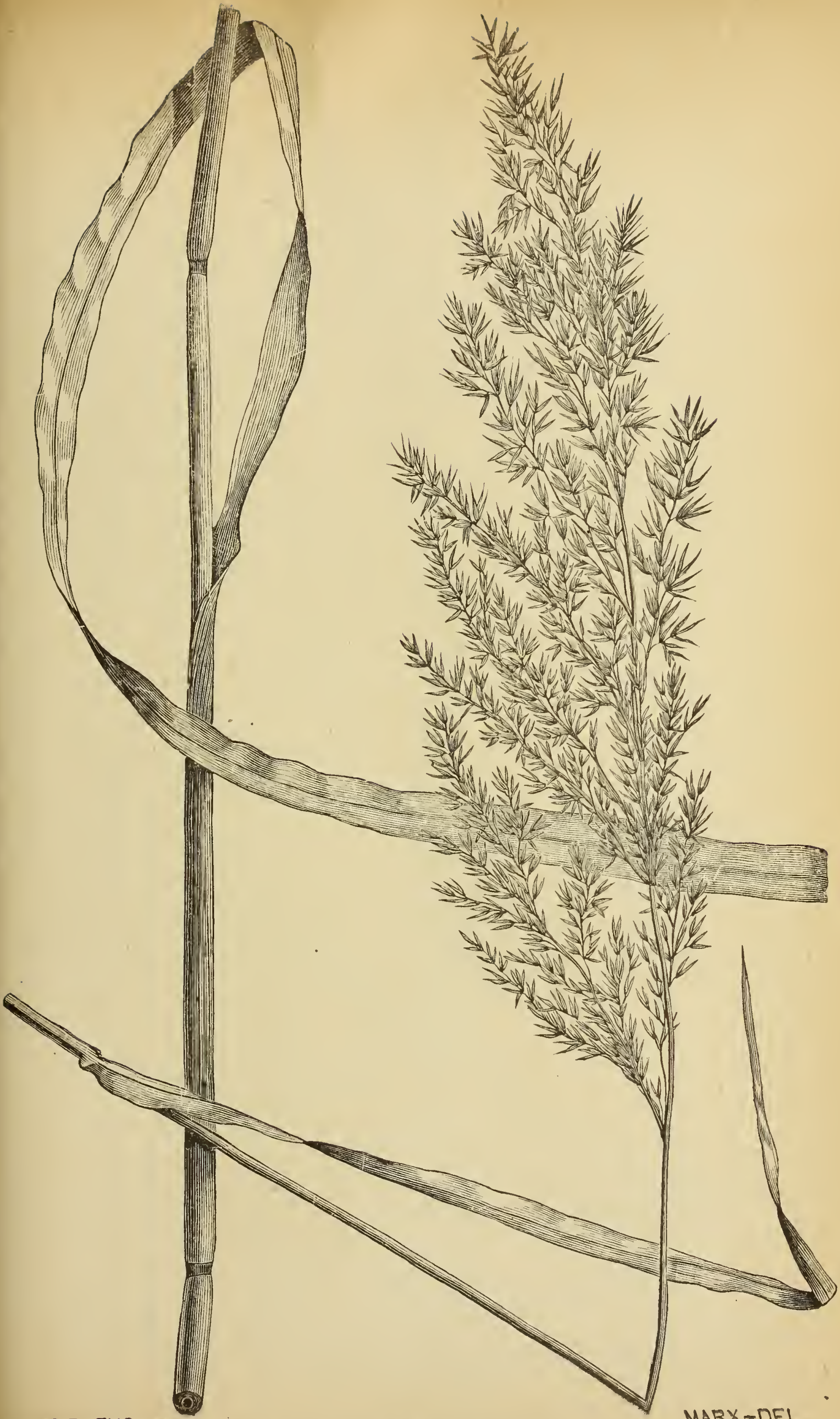

NICHOLS-ENG. MARX-DEL.

PLATE 25—Blue Joint.

BIG SAND GRASS.

(*Calamovilfa longifolia* (Hook.) Scribner.)

Stems stout, erect, from very large, strong, scaly, creeping root-stocks, smooth, two to six feet high, all but the uppermost internode completely covered by the sheaths; leaves numerous, smooth, one to two feet in length. flattish or becoming involute, rigid, tapering into a long, slender point; ligule a narrow, woolly ring—the hairs more plentiful at the angles on either side; panicle from close (while young) becoming spreading and open, six inches to two feet long; spikelets whitish or often tinged with purple, one-fourth to one-third of an inch long; flowering glume nearly or quite equalling the upper or larger empty glume; the copious tuft of hair one-half to two-thirds as as long as the flowering glume. Plate 26.

This is a native grass easily recognized by its large, pale panicles, numerous large, rigid leaves, and large creeping root-stocks. It occurs over the entire state but is most plentiful in the James River Valley and the region to the west of it. It thrives best in moist sandy or saline soils. It is too coarse to be recommended as a hay grass when other and finer growing species are available. The yield is always heavy and if cut in proper season the hay is of fair quality. In certain parts of the state it furnishes a considerable percentage of the winter forage and hence is of considerable value to the stock raisers in those localities. The specimens analyzed were collected at Forest City the 1st of September, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.26	——
Ash	4.65	5.07
Ether Extract	1.63	1.78
Crude Fibre	37.92	41.33
Crude Protein	3.34	3.84
N.-free Extract	44.20	48.18
Total Nitrogen	.53	.58
Albuminoid Nitrogen	.43	.47

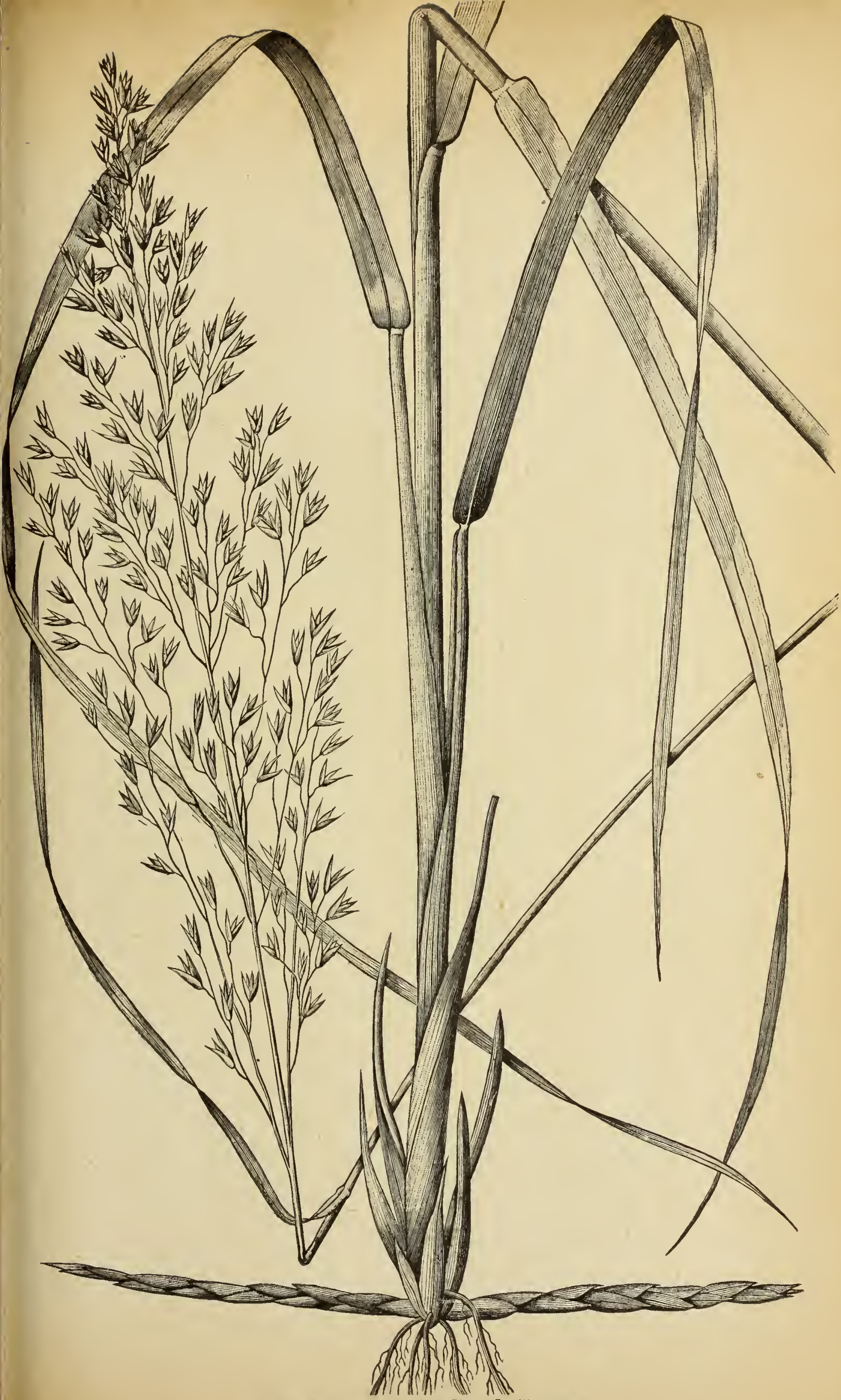


Plate 26—Big Sand Grass.

SAND GRASS.

(*Calamagrostis confinis* Nutt.)

Stems rather robust, erect, from stout perennial roots, often somewhat branching below, smooth except near the panicle where it is roughish, green with joints purplish brown, leaves large, flattish, but becoming more or less involute, eight inches to a foot or more in length (the root leaves often over a foot and a half long), rough, particularly on the margins; sheaths usually roughish; ligule narrow and obtuse, about one-eighth of an inch in length; flowers in a close, short-branched panicle which is from four to seven inches long; spikelets about one-sixth of an inch long; empty glumes thickish, roughened, three-nerved; flowering glume nearly as long as the empty glumes, acute, thinnish, bearing a twisted awn from below the middle; palet nearly as long as the glume; hairs plentiful, shorter than the glumes.

This grass is not nearly so plentiful as blue joint from which it may be distinguished by its paler, closer panicles, larger flowers, involute leaves and generally smaller size of the whole plant. Thus far it has not been reported from outside of the Sioux Valley. It occurs generally in rather drier soil than does the common blue joint, and prefers sandy places—hence the common name—sand grass. If it were more plentiful it would be of considerable value as a forage grass—the abundance of root leaves furnishing a good yield of excellent hay. It is, however, of too rare occurrence to take any important place among native forage plants. The specimens analyzed were collected at Brookings, July 3rd, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.02	——
Ash	7.24	7.79
Ether Extract	2.01	2.16
Crude Fibre	35.29	37.95
Crude Protein	5.47	5.88
N.-free Extract	42.97	46.21
Total Nitrogen	.88	.94
Albuminoid Nitrogen	.78	.83

BIG CROW'S FOOT.

(*Eleusine coracana* Gaertn.)

Stems erect, very robust, smooth, branching, one to three feet high, from coarse, fibrous annual roots; leaves numerous, large, a foot or more in length, usually longer than the stem, flat, smooth or roughish on the margins; flowers arranged in spikes which are one-sided, digitately clustered (three to seven in a cluster) one and one-half to two inches long, densely flowered.

This is a coarse grass native to India and Africa which has been introduced into various parts of the United States. It makes a very rank growth and hence yields a heavy crop of hay which is not well relished by stock. It is rather tender for our climate and does much better in the South. On the grounds of the Experiment Station this grass gave a paying crop in 1891, but the next year the yield was very light, showing that it would not be a sure crop for a short season. It is, therefore, not as satisfactory an annual as either common millet or broom corn millet. The specimens analyzed were cut from the experimental plats on the Station grounds on the 9th of August. 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.81	——
Ash	10.25	11.00
Ether Extract	2.49	2.67
Crude Fibre	27.31	29.31
Crude Protein	11.50	12.34
N.-free Extract	41.64	44.68
Total Nitrogen	1.84	1.98
Albuminoid Nitrogen	1.09	1.17

TALL OAT GRASS.

(*Arrhenatherum elatius* (L.) M. K.)

Stems stout, erect, two to four feet high, from a mass of perennial, fibrous roots, leafy; leaves broad and flat, six to ten inches long, rough (the sheaths smooth), pointed; panicle narrow, loose, five to ten inches long; spikelets on rather short stalks, two-flowered (the lower one staminate only, the upper one perfect), about three-eighths of an inch long; empty glumes very unequal, the lower one smaller and one-nerved, the upper three-nerved, both thin and transparent, without awns; flowering glume seven nerved, hairy at the base, roughish; the flowering glume of the lower flower has a long, twisted, bent awn proceeding from its back just below the middle; that of the upper flower has only a small bristle-like awn near its apex. Plate 27.

Tall oat grass is a native of the Old World world where it is one of the most valued grasses both for hay and for pasturage. It makes a strong root-growth and lasts well in pastures. It does well in most localities in the Southern and Eastern United States. On the grounds of the Experiment Station it has promised well. It is an excellent grass for use in mixtures with such species as tall fescue, smooth brome, orchard grass and meadow fescue. It gives an abundant yield of hay and, up to the present, has proved hardy. It is deserving of trial on all but the very driest of soils. Its hardiness is shown from the fact that it has often escaped from cultivation and continues to thrive. The specimens analyzed were cut from the experimental plats on the Station grounds on the 30th of June, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.84	——
Ash	7.90	8.48
Ether Extract	2.85	3.06
Crude Fibre	28.72	30.83
Crude Protein	7.11	7.63
N.-free Extract	46.58	50.00
Total Nitrogren	1.14	1.22
Albuminoid Nitrogen	.95	1.02

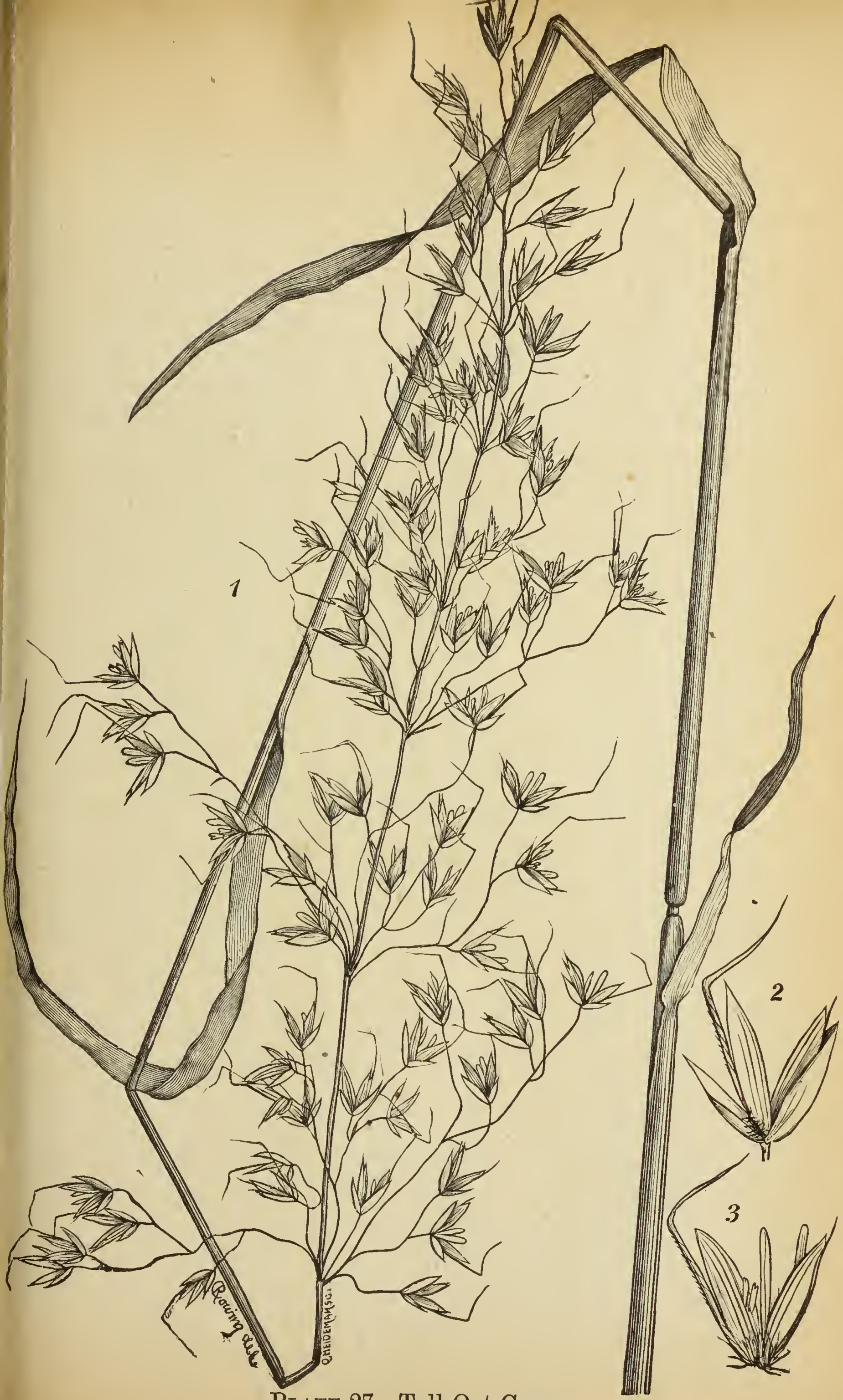


Plate 27—Tall Oat Grass.

CORD GRASS.

(*Spartina cynosuroides* (L.) Willd.)

Stems upright, stout, becoming hard and woody, three to seven feet high, from very large, scaly, perennial root-stocks; leaves two or three feet long, involute, pointed, tough and rigid, rough on the margins; spikes five to twenty, usually from one and one-half to three inches long, upright at first but becoming somewhat spreading at maturity; spikelets nearly half an inch long, one-flowered, flattened, sessile and crowded closely together in two rows; glumes awn-pointed with minute bristles along the back. Plate 28.

Common in low places throughout the entire West. It is particularly plentiful in draws in the Eastern part of the State and among the "Coteaus." It is the most common of the "slough grasses" and is of considerable value as a hay grass. If allowed to stand too long it becomes woody and yields a poor quality of hay but when cut in proper season is readily eaten by stock. The stems contain a considerable amount of sugars and hence are quite palatable even though hard and tough. In the drier regions in the central and western parts of the state it is largely replaced by the "Little Cord Grass" (*Spartina gracilis*.) The specimens analyzed were collected at Brookings on the 10th of July, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.45	——
Ash	3.81	4.07
Ether Extract	1.13	1.21
Crude Fibre	36.03	38.51
Crude Protein	4.95	5.29
N.-free Extract	47.63	50.91
Total Nitrogen	.79	.85
Albuminoid Nitrogen	.58	.62

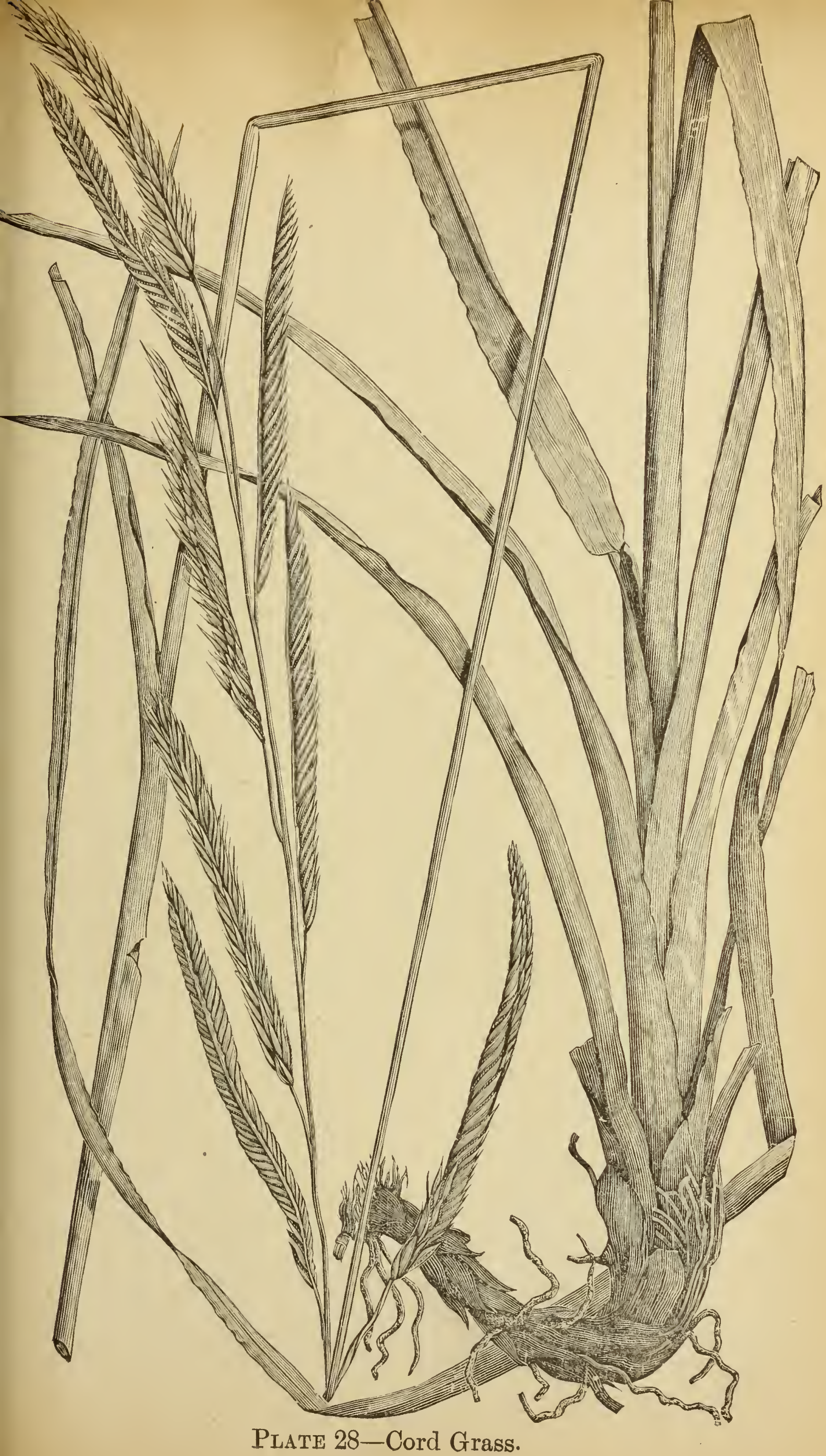


Plate 28—Cord Grass.

WILD CRAB GRASS.

(*Schedonnardus paniculatus* (Nutt.) Coville.)

Stems low, weak and spreading, branching, six to eighteen inches high, leafy below, naked and more or less curved above, rough, from annual fibrous roots; leaves short narrow, roughish; panicle consisting of from three to ten distant, slender, straight or curved, widely spreading spikes, which are one to four inches long; spikelets small, sessile, appressed to the axis of the spike, one flowered; empty glumes unequal, rough on the keel, with sharp, awn-like points, shorter than the flowering glume.

Found plentifully throughout the state on dry soils. Readily distinguished from common crab grass by its curved, spreading panicles, its general habit of growth and the structure of its flowers. It furnishes a small amount of pasturage but is, on the whole, rather to be regarded as a weed than as a forage plant. The specimens analyzed were collected the latter part of August.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.60	——
Ash	9.14	9.79
Ether Extract	2.43	2.60
Crude Fibre	32.01	34.27
Crude Protein	7.50	8.02
N.-free Extract	42.32	45.31
Total Nitrogen	1.20	1.28
Albuminoid	.91	.98

BLACK GRAMA.

(*Bouteloua hirsuta* Lag.)

Stems slender, erect, tufted, smooth, six to fifteen inches high, from a mass of long and slender, but tough, fibrous roots; perennial; leaves most plentiful on the lower part of the stem, narrow, flat, usually covered with long, white hairs, one to three inches long; spikes one to three, or rarely four, densely flowered, about one inch in length; empty glumes usually dark purple, hairy on the back, each hair arising from a blackish wart; rudimentary flower with a smooth stalk.

Black grama occurs throughout the state but is less common than blue grama. It prefers dry soils and in the Eastern part of the state is most often found on dry and rocky places where very few other grasses will grow. It is quite variable both as to size and hairiness. In the western part of the state it often grows mixed with blue grama and adds considerably to the amount of native forage. Like blue grama it is often called buffalo grass. The specimens analyzed were collected at Dell Rapids on the first of September, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.28	——
Ash	9.40	10.14
Ether Extract	2.36	2.55
Crude Fibre	30.45	32.84
Crude Protein	5.45	5.88
N.-free Extract	45.06	48.60
Total Nitrogen	.87	.94
Albuminoid Nitrogen	.67	.73

BLUE GRAMA.

(*Bouteloua oligostachya* (Nutt.) Torr.)

Stems slender, erect, tufted, smooth, eight to sixteen inches high, from very tough, perennial, fibrous roots and slender rootstocks, very leafy below; the upper stem leaves short, narrow and pointed, involute, lower stem leaves and root leaves larger (three to five inches long), flattish or involute, long-pointed, leaves and sheaths all smooth; spikes one to three (rarely four or five), usually from one to two inches long, one-sided and more or less curved, densely flowered; spikelets about one-fifth of an inch long, containing one fertile flower and one or more sterile or rudimentary ones; empty glumes unequal, sparingly hairy on the back, dark purple; glumes of fertile flower soft-hairy, the lower (flowering glume) three lobed, the lobes awl-pointed, the upper (palet) two-lobed; sterile flower copiously white hairy at the top of its pedicel, its glume with three awns. Plate 29.

This is one of the commonest grasses in the state. In the eastern part it grows chiefly on the dry gravelly knolls but in western part, particularly on the "Range," it covers all the drier prairies. It is often, but improperly, called "buffalo grass." Over the larger portion of the western half of the state it furnishes by far the greater part of the pasturage. It cures well in autumn and hence furnishes excellent winter forage. Stock will usually keep in good condition upon it as long as it remains uncovered by the snow. It is of little or no value for hay as its leaves are too short and are closely matted to the ground. In open winters stockmen often winter large herds upon it with little or no other feed. The specimens analyzed were collected at Brookings on the 10th of July, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.69	——
Ash	8.11	8.69
Ether Extract	2.03	2.18
Crude Fibre	29.30	31.40
Crude Protein	8.50	9.11
N.-free Extract	45.37	48.62
Total Nitrogen	1.36	1.46
Albuminoid Nitrogen	1.08	1.16

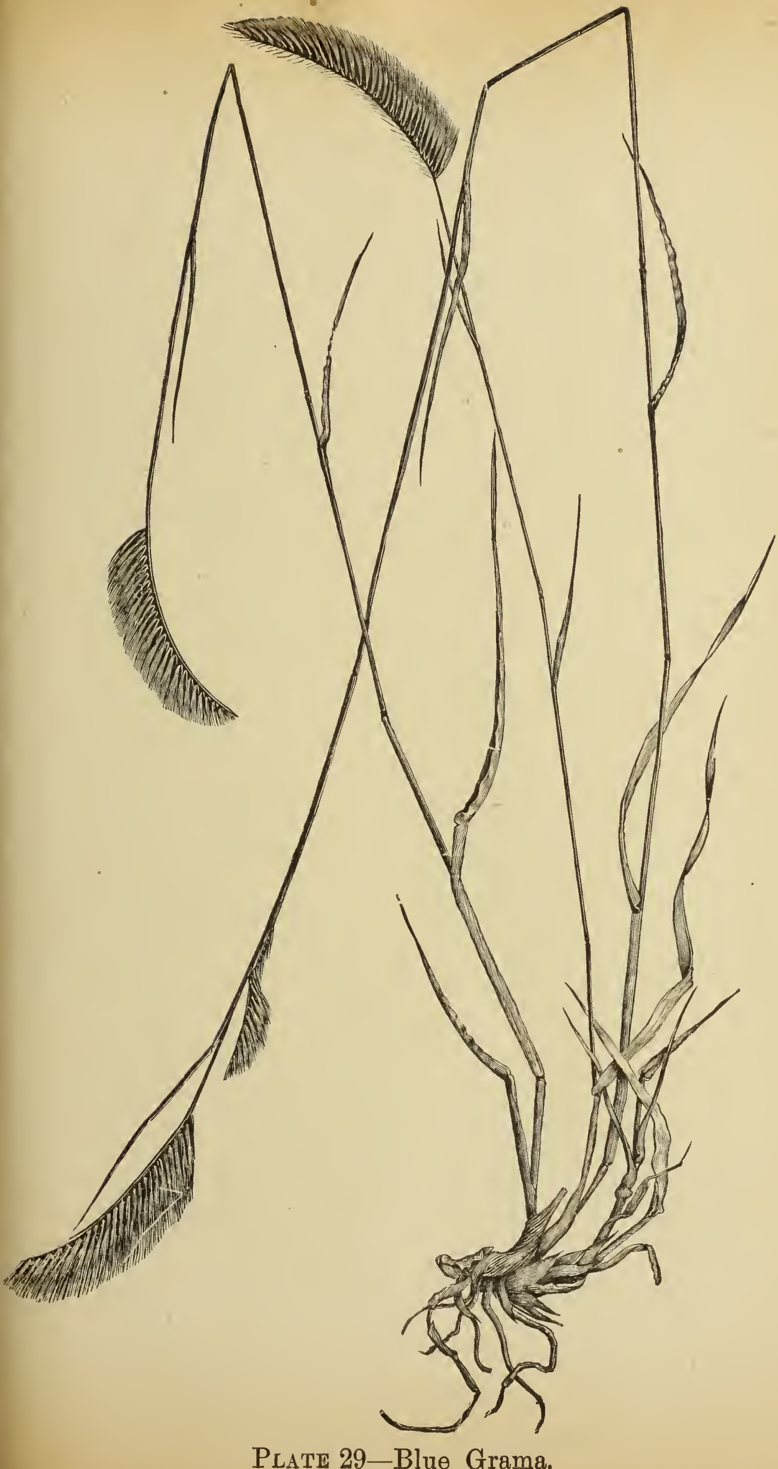


PLATE 29—Blue Grama.

TALL GRAMA OR MESQUITE GRASS.

(*Bouteloua curtipendula* (Michx.) Gray.)

Stems rather stout, erect, tufted, one to three feet high, from very tough, perennial, fibrous roots, with short, scaly off-shoots, leafy below; leaves flattish, narrow and long pointed, smooth or hairy; root leaves very long and plentiful; spikes about one-half of an inch long, numerous (twenty to sixty), generally purplish, arranged on one side of the stem some distance apart, reflexed; spikelets usually four to ten in each spike, about one-fifth of an inch long. Plate 30.

Tall Grama is found throughout the entire state and grows chiefly on upland prairies. It may be easily recognized by the one-sided arrangement of the numerous spikes. It is a very valuable forage grass, particularly when used for hay. In the eastern part of the state it is often found growing with the blue stems. Stock eat it readily as hay but are not as fond of it in pasturage as of the blue stems or of the blue grama. It is not so shy of civilization as are the other gramas and hence becomes of much value in the interim of the going out of these and the buffalo grass and the coming in of the blue stems. It has not yet been successfully cultivated. The specimens analyzed were cut on a prairie meadow, near Brookings, the last of August, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.05	——
Ash	9.07	9.76
Ether Extract	1.72	1.85
Crude Fibre	35 10	37.76
Crude Protein	5.19	5.58
N.-free Extract	41.87	45.05
Total Nitrogen	.83	.89
Albuminoid Nitrogen	.63	.67

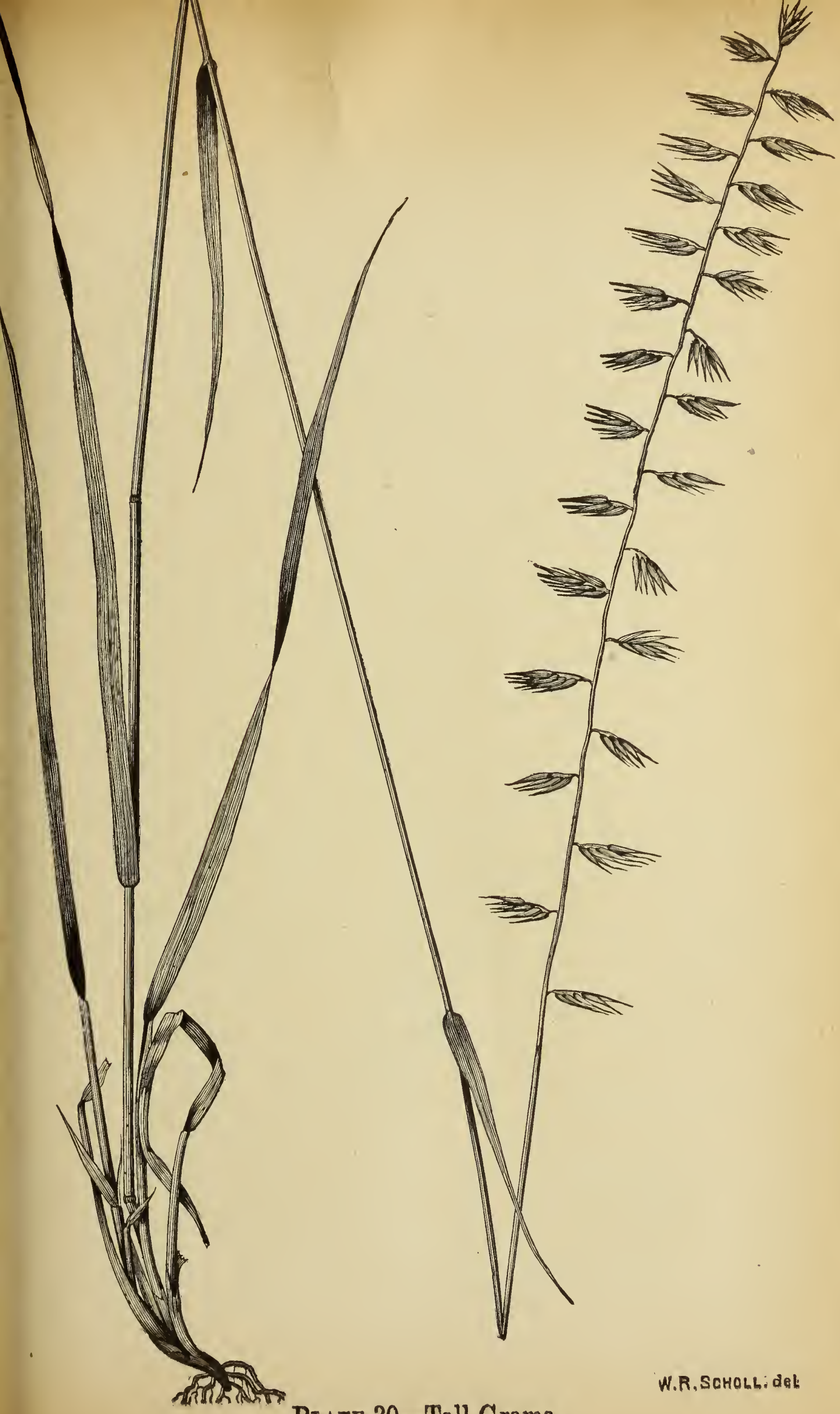

W.R. SCHOLL, del.

PLATE 30—Tall Grama,

BUFFALO GRASS.

(*Bulbilis dactyloides* (Nutt.) Raf.)

Stems smooth, running along on the ground, rooting at the joints, forming close, broad mats which are often several yards in extent; leaves two to five inches long, smooth or with scattered, white hairs on the edges, more or less curled and twisted; flowers of two sorts, borne on the same or on different plants; staminate spikes one to three, whitish, about one-half an inch long, clustered at the end of slender, upright stems which are four to six inches long; pistillate spikelets one-flowered, in a loose head, at the end of a short (one to three inches) stem.

Plate 31 showing staminate plant on the left and pistillate plant on the right, both natural size.

Buffalo grass was formerly very common in all parts of the state. At present, it is exceedingly rare in the Sioux Valley; but as one goes further west it becomes more plentiful. In many parts of the James Valley it is still quite common. It is most abundant in the region west of the Missouri river, but furnishes a small amount of pasturage as compared with the blue grama. It is very nutritious and hence is much sought after by stock of all kinds. As a winter forage it is without an equal. As long as stock can get plenty of this grass they will keep in excellent condition without any other food. It is rapidly giving way to other stronger growing grasses and the probabilities are that within a compartively short period of time, it will be very scarce throughout the entire Missouri Valley. In Nebraska it is already very rare except in the western counties. The specimens analyzed were collected at Iroquois the first of August, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.24	——
Ash	10.38	11.19
Ether Extract	2.28	2.46
Crude Fibre	26.66	28.74
Crude Protein	5.19	5.60
N.-free Extract	48.25	52.02
Total Nitrogen	.83	.89
Albuminoid Nitrogen	.67	.72

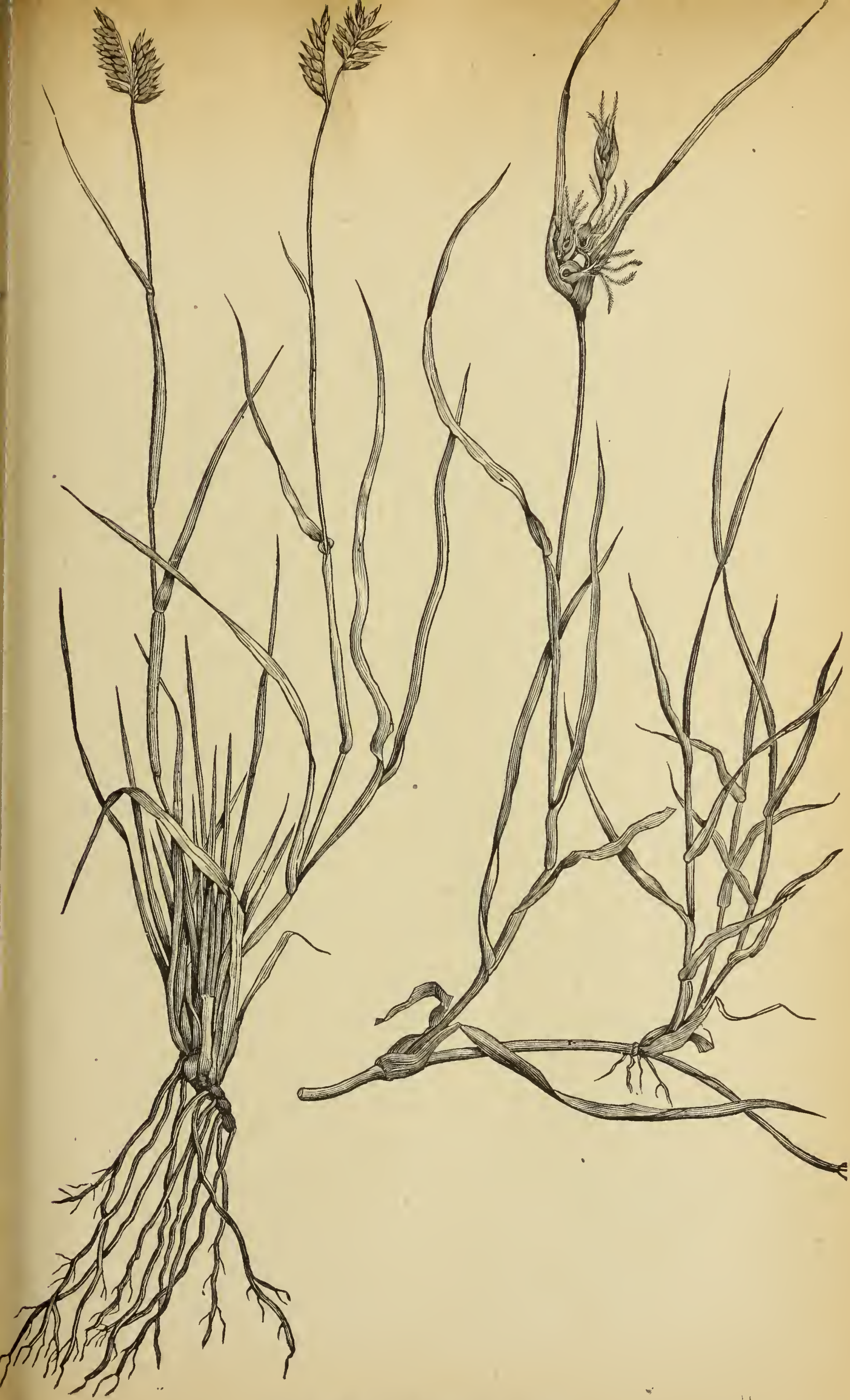


Plate 31—Buffalo Grass.

SLOUGH GRASS.

(*Beckmannia erucaeformis uniflora* Scribn.)

Stems stout, erect or bent at the lower joints, usually tufted, one to four feet high, from perennial, fibrous roots; leaves broad and flat, four to eight inches long, with rough blades and smooth sheaths; panicle narrow, upright, one-sided, the short, crowded, spike-like branches densely flowered throughout; spikelets whitish, compressed, nearly circular in outline, abruptly pointed, one flowered; empty glumes boat-shaped, inflated; flowering glume acute.

This grass occurs throughout the state in sloughs and other wet marshy places. It is most plentiful in the Sioux and James Valleys. Though harsh and woody when old it is quite palatable when young and is readily eaten by stock. It often occurs in such quantities as to constitute an important part of the forage of low pasture lands. It may be easily recognized by the peculiar spike-like branches of the panicle, which remind one of the rattles of a rattle-snake. For this reason it is sometimes called "rattle-snake grass." It often becomes very plentiful about artesian wells after they have been running for sometime and may yet prove to be of value under cultivation. The specimens analyzed were cut on the College farm, June 30th, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.58	——
Ash	7.82	8.46
Fther Extract	1.94	2.10
Crude Fibre	35.61	38.53
Crude Protein	5.71	6.18
N.-free Extract	41.34	44.73
Total Nitrogen	.91	.99
Albuminoid Nitrogen	.81	.87

FALSE BUFFALO GRASS.

(*Munroa squarrosa* Torrey.)

Stems wiry, rough, prostrate and creeping, very much branched, (the branches coming out in clusters) rooting at the joints; roots annual, fibrous; leaves numerous, clustered, short, rigid, with very sharp, spine-like points, rough, strongly nerved, margins often whitish; spikelets three-flowered, in clusters at the ends of the branches and surrounded by a whorl of leaves; whole plant pale green and glaucous.

A weedy grass of little or no value agriculturally. It is found in sandy soil along the Missouri, Cheyenne and other streams in the western part of the state. It often occurs in the bare places about ant hills and the seeds are thought to be used by the ants for food. The grass may be readily recognized by its clustered, sharp-pointed leaves and matted habit of growth. The mats are often several feet in extent. The specimens analyzed were collected at Forest City the 1st of September, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	5.20	——
Ash	16.90	17.83
Ether Extract	1.74	1.84
Crude Fibre	29.34	30.95
Crude Protein	6.58	6.94
N.-free Extract	40.24	42.45
Total Nitrogen	1.05	1.11
Albuminoid Nitrogen	.83	.88

REED GRASS.

(*Phragmites vulgaris* (Lam.) B. S. P.)

Stems very tall and stout, five to ten or more feet high and sometimes almost an inch in diameter, from very coarse fibrous roots and large, scaly creeping stems which are at or near the surface of the ground; leaves broad (one to two inches) and flat, smooth; panicle very large, loose, more or less nodding, about one foot long, reddish, becoming woolly at maturity. Plate 32.

This is the tallest and coarsest grass found in the state. It has a very wide distribution and grows in shallow water in ponds and sloughs and along the margins of lakes and larger streams. Stock seldom eat it except when it is young or when the better grasses are scarce. It is sometimes cut for early hay. In sandy soil along the Missouri River the creeping stems often grow to a great length. Each joint of the stem strikes root and gives rise to an upright stem bearing leaves and flowers. The large panicles are often used for decorative purposes. The specimens analyzed were obtained on the College farm the first of August, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.54	——
Ash	6.60	7.14
Ether Extract	2.65	2.87
Crude Fibre	36.08	39.02
Crude Protein	8.42	9.11
N.-free Extract	38.71	41.87
Total Nitrogen	1.35	1.46
Albuminoid Nitrogen	1.08	1.16

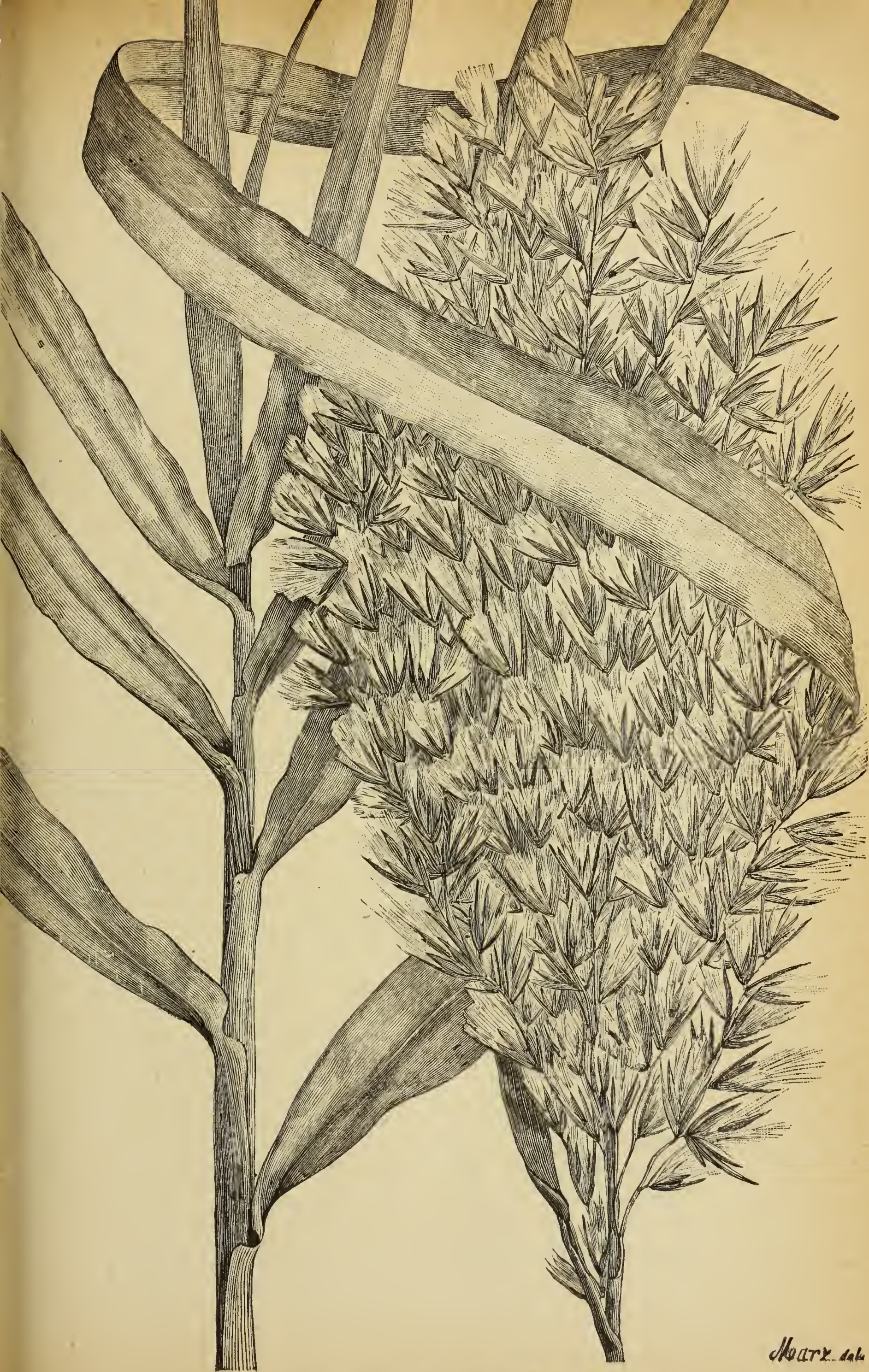


PLATE 32—Reed Grass.

SPIKE GRASS.

(*Diplachne fascicularis* (Lam.) Beauv.)

Stems weak, branching, spreading, ascending from a decumbent base, smooth and soft, twelve to eighteen inches long, from annual fibrous roots; leaves smooth, long (often exceeding the stems in length), with long, tapering points, the uppermost at first sheathing the base of the paniculate spikes; spikes one to four inches long, loosely arranged on one side of the central axis, spikelets about one-half of an inch long, short-stalked, seven to eleven flowered, greenish or purplish; flowering glume hairy margined near the base, roughish on the back, toothed at the apex, with a short awn.

This grass occurs sparingly in the eastern and central part of the state. It grows only in wet places and in shallow water. It makes a soft and very palatable forage but is too scarce to be of much importance. The specimens analyzed were collected in Potter county in the early part of September, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.55	—
Ash	9.08	9.73
Ether Extract	1.96	2.10
Crude Fibre	33.95	36.37
Crude Protein	8.89	9.52
N.-free Extract	39.47	42.28
Total Nitrogen	1.42	1.52
Albuminoid Nitrogen	1.01	1.08

SLENDER MEADOW GRASS.

(*Eragrostis pilosa* (L.) Beauv.)

Stems slender, upright or more often bent at the lower joints, branching, smooth, six to fourteen inches high, from annual fibrous roots; leaves narrow, flat, soft, pointed; panicle oblong, becoming more or less elongated, rather thickly flowered, the branches at first erect but spreading at flowering time; spikelets lead-colored, one-third of an inch or less in length, equalling or somewhat shorter than the pedicels, five to twelve flowered; glumes obtuse; the flowering glume broadly ovate with a single nerve.

Slender meadow grass is a weedy annual, introduced from the Old World and found but sparingly in the Sioux Valley. It grows chiefly in waste places and along roadsides and is of no agricultural importance. The specimens analyzed were collected at Brookings in the early part of August, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.59	———
Ash	9.43	10.10
Ether Extract	2.28	2.44
Crude Fibre	26.89	28.79
Crude Protein	14.23	15.23
N.-free Extract	40.58	43.44
Total Nitrogen	2.28	2.44
Albuminoid Nitrogen	1.73	1.86

STINK GRASS.

(*Eragrostis multiflora* (Forsk.) Asch.)

Stems bent at the lower joints, diffusely spreading and ascending, smooth, internodes exceeding the sheaths of the leaves, eight to eighteen inches long, from annual, fibrous roots; leaves broad, flat, smooth, two to six inches long; panicle large, oblong or pyramidal, three to six inches long, loosely or compactly flowered; spikelets ten to fifty flowered, one-fourth to three-fourths of an inch long, lead-colored, whitish when old; flowering glume with a rough keel and conspicuous lateral nerves. Plate 33.

Stink grass or, as it is sometimes called, candy grass, is a native of the Old World that has become naturalized in many parts of the United States. It is quite common in South Dakota, particularly in the older settled portions. The grass is coarse and weedy and has such a disagreeable odor while fresh that animals do not relish it. This odor disappears upon drying the grass hence the hay is more palatable. Stink grass thrives on a variety of soils and under favorable circumstances often becomes a weed. As it is an annual, it is not difficult to keep in check with proper cultivation. It is scarcely to be regarded as of much importance either as a forage plant or as a weed. The specimens from which the analysis was made were collected at Brookings on the 8th of August, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.76	——
Ash	10.09	10.82
Ether Extract	2.00	2.15
Crude Fibre	35.83	38.43
Crude Protein	13.41	14.38
N.-free Extract	31.91	34.22
Total Nitrogen	2.15	2.30
Albuminoid Nitrogen	1.55	1.66

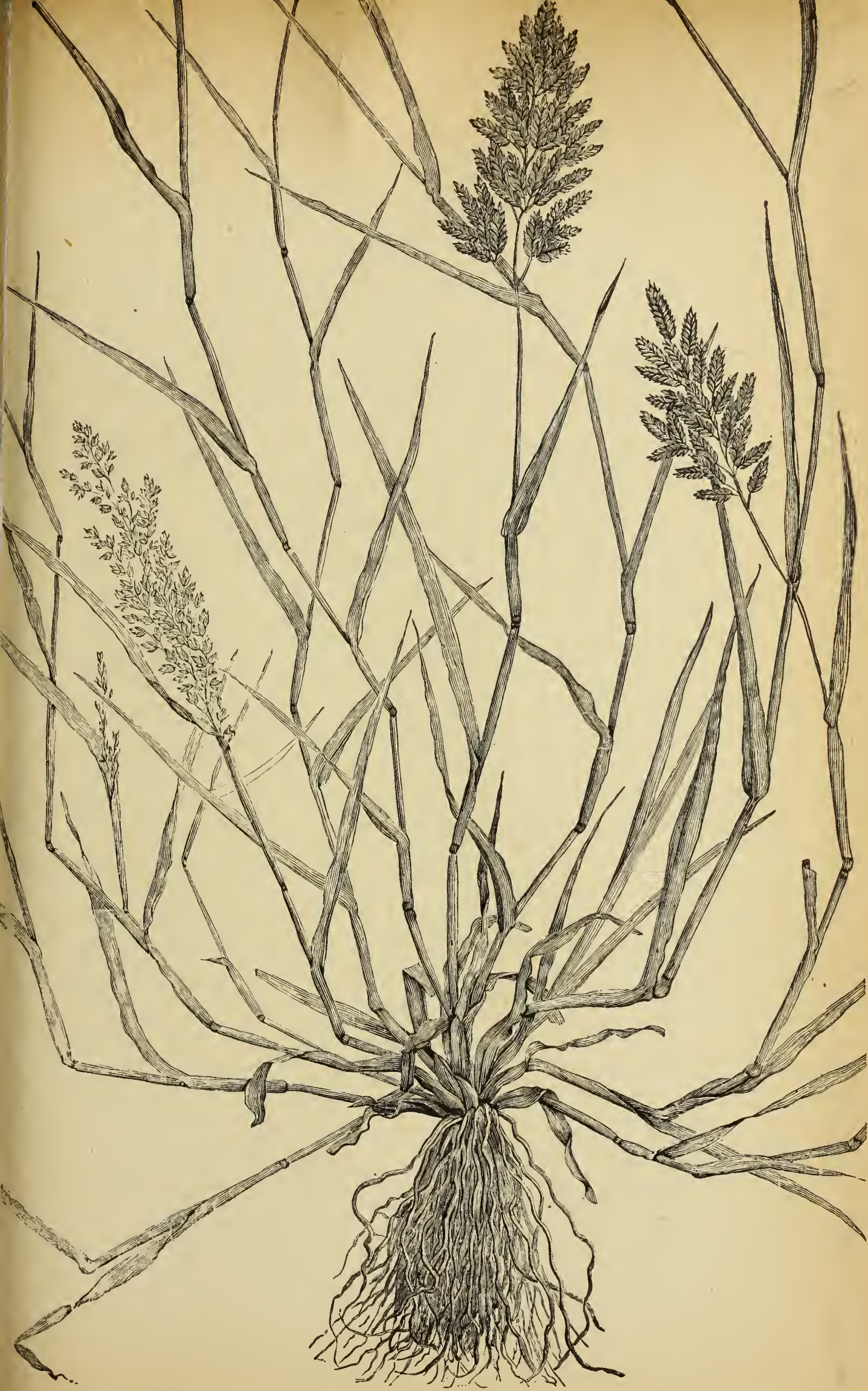


PLATE 33—Stink Grass.

SOUTHERN SPEAR GRASS.

(*Eragrostis purshii* Schrad.)

Stems slender, sparingly branched from near the base, bent at the lower joints, then upright, six inches to two feet high, smooth; roots fibrous; leaves narrow, pointed, flat, softish, smooth; panicle large, elongated, open, with widely spreading capillary branches; spikelets lead-colored, five to eighteen flowered, usually much shorter than the roughish pedicels; glumes acute; the flowering glume with three nerves.

This grass is not uncommon in the eastern and southern parts of the state. It is very close to the preceding species but is generally larger with larger and more spreading panicles, larger spikelets and three-nerved flowering glumes. Stock eat it readily as a forage but it is too scarce to be of much value. It usually grows in waste places and along roadsides. The specimens analyzed were collected at Brookings in August, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	5.48	——
Ash	12.11	12.81
Ether Extract	1.73	1.83
Crude Fibre	25.61	27.10
Crude Protein	10.94	11.57
N.-free Extract	44.13	46.69
Total Nitrogen	1.75	1.85
Albuminoid	1.37	1.45

EARLY OR PRAIRIE BUNCH GRASS.

(*Eatonia obtusata* (Michx.) Gray.)

Stems erect, rather slender, unbranched, tufted, roughish, from fourteen inches to two and one-half feet high; roots perennial, fibrous; leaves numerous, flat, rough, two to six inches long; panicle dense, spike-like, interrupted, three to five or six inches long; spikelets small, crowded; upper empty glume, obovate, with a rounded obtuse apex.

Early bunch grass is quite widely distributed throughout the state but is most plentiful in the eastern and southeastern parts. It grows well on nearly all dry soils but does best on the moister prairies. It is one of the earliest of our native species, ripening its seeds in June or July. Wherever it occurs in any considerable quantity it is a valuable grass for both hay and pasture. This grass and wild June grass furnish a large amount of early pasturage in many localities in the eastern half of the state and are important elements in most of the upland pastures. The specimens analyzed were cut on the College farm on the 15th of July, 1891, and were just going out of bloom.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.64	——
Ash	12.72	13.77
Ether Extract	2.38	2.58
Crude Fibre	30.22	32.72
Crude Protein	7.01	7.59
N.-free Extract	40.03	43.34
Total Nitrogen	1.12	1.21
Albuminoid Nitrogen	.97	1.05

EATON'S GRASS.

(*Eatonia pennsylvanica* (Spreng.) Gray.)

Stems erect, slender, simple, tufted, smooth and shining, one and one-half to three and one-half feet in height, from perennial, fibrous roots; leaves flat, rough, three to six inches long; panicle slender, elongated (four to eight inches long), loose, branched, often nodding; spikelets small, loosely arranged on the slender branches of the panicle; upper empty glume narrower than in the preceding species, often with a blunt point.

This grass is found throughout the state but is less common than the preceding species. It prefers low meadows and moist woodlands and is too rare to be of much importance as a forage plant. Whenever it does occur, stock eat it readily. The specimens analyzed were collected along the Sioux River, near Brookings, on the 16th of July, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.02	———
Ash	12.93	13.76
Ether Extract	2.78	2.96
Crude Fibre	32.31	34.38
Crude Protein	7.96	8.47
N.-free Extract	38.00	40.41
Total Nitrogen	1.25	1.33
Albuminoid	1.18	1.26

REED FESCUE.

(*Scolochloa arundinacea* (Lilj.) Macm.)

Stems robust, erect, smooth or roughish, three or four feet high, from perennial, creeping root-stocks; leaves narrow' about one-foot long, long-pointed, rough on the margins; panicle narrow, six to ten inches long, branches erect; spikelets about one-third of an inch long, usually three-flowered; empty glumes thin and papery, unequal, the lower three-nerved, the upper one five-nerved, ragged toothed at the apex; flowering glume rather rigid, seven-nerved, the obtuse apex as if gnawed; flowers with a tuft of hairs at the base of each.

This grass seems to be very rare in South Dakota, having been found in but one locality. It grows in shallow water and probably occurs throughout the Sioux Valley. It has little, if any, agricultural value. The specimens analyzed were collected at Brookings on the 20th of June, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.34	——
Ash	7.42	8.01
Ether Extract	1.19	1.28
Crude Fibre	35.30	38.10
Crude Protein	5.71	6.16
N.-free Extract	43.04	46.45
Total Nitrogren	.91	.99
Albuminoid Nitrogen	.69	.75

PRAIRIE JUNE GRASS.

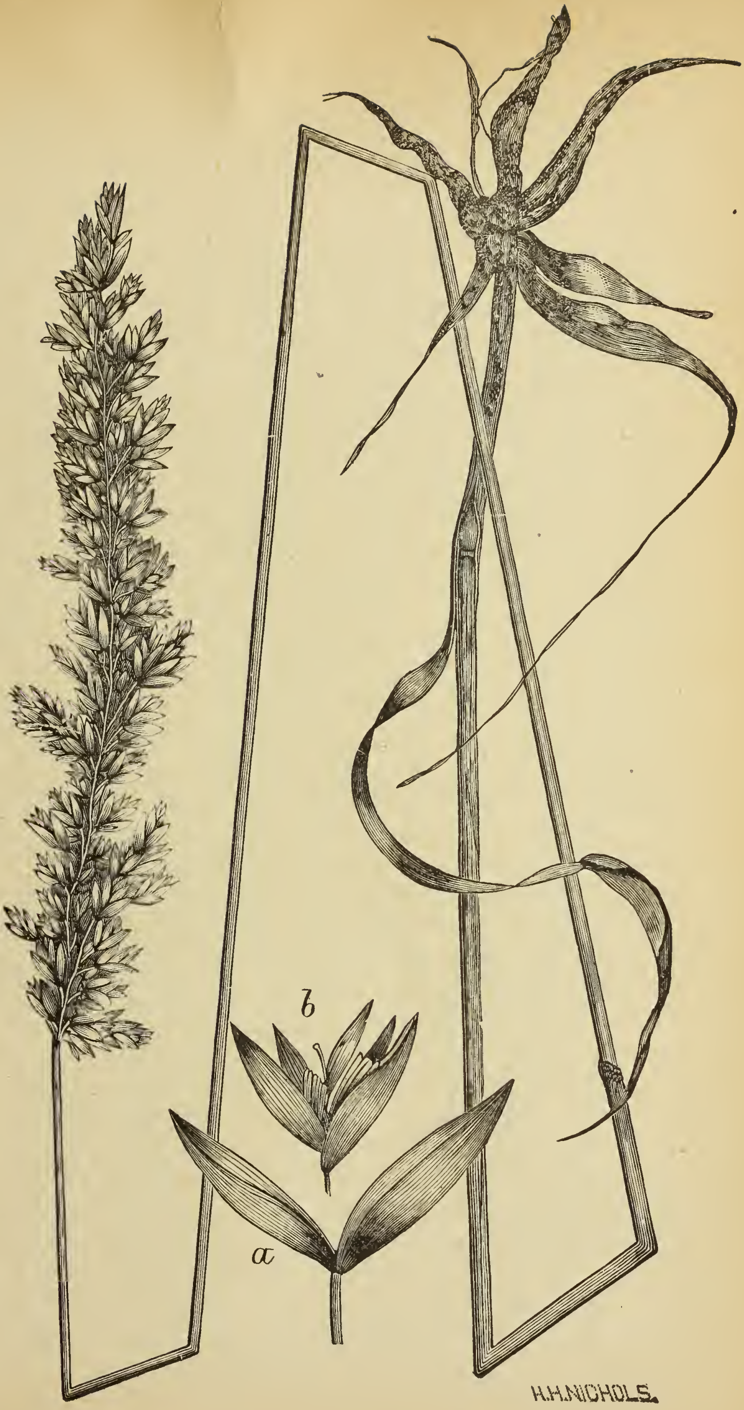
(*Koeleria cristata* Pers)

Stems erect, tufted, one to two and one-half feet high, from perennial, fibrous roots; leaves flat (or in very dry localities more or less rolled), the root leaves sometimes a foot or more long; whole plant often becoming glaucous and covered with short hairs; panicle narrow and spike-like, more or less interrupted at the base, densely flowered, two to six inches long (usually about three inches); spikelets small, two to four-flowered; glumes keeled, obscurely three-nerved; flowering glume acute or bristle-pointed. Plate 34.

Prairie June grass, wild June grass or prairie bunch grass is one of the commonest and one of the earliest grasses of our high prairies. The seeds are usually ripened early in July. The grass is a very valuable one in upland pastures as it thrives on dry hills and sandy prairies and is readily eaten by all kinds of stock. It produces a fine growth of root-leaves which are often a foot to eighteen inches long in favorable localities. Under such circumstances the grass is valuable for early hay. It promises to be of value for cultivation, the quality and yield of the forage being very much improved. The specimens analyzed were collected at Brookings on the 6th of July, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.89	——
Ash	9.95	10.80
Ether Extract	4.33	4.70
Crude Fibre	27.59	29.95
Crude Protein	7.23	7.84
N.-free Extract	43.01	46.69
Total Nitrogen	1.16	1.26
Albuminoid Nitrogen	1.16	1.26



T.TAYLOR.DEL.

PLATE 34—Prairie June Grass.

SALT GRASS.

(*Distichlis spicata stricta* Thurber.)

Stems erect, tufted, branched, six to eighteen inches high, with wide spreading, perennial, scaly root-stocks, leafy, covered nearly to the top with the numerous, more or less overlapping sheaths; leaves two ranked, rigid, narrow and rolled, smooth, sharp-pointed, usually from three to six inches long; panicle short and spike-like or rather loose (especially on staminate plants); spikelets seldom numerous, straw-colored, ten to twenty flowered, flat, about one-half an inch long; flowering glumes sharply keeled, acute. Plate 35.

Salt grass as its name indicates, grows in saline or alkaline soils, and is plentiful throughout the greater portion of the state. It is usually the chief element of the vegetation about the so-called "burn-outs" or "poison spots" found in various parts of the state. The grass is often cut for hay in the drier regions. It is quite tough and woody and hence the forage is of an inferior quality. When it is fresh animals eat it but are not so fond of it as of most other grasses. The flowers are unisexual and the panicles of the staminate plants are usually somewhat loose and spreading while those of the pistillate plants are close and spike-like. The specimens analyzed were collected at Iroquois on the 1st of August, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.03	——
Ash	9.61	10.45
Ether Extract	2.47	2.69
Crude Fibre	27.57	29.98
Crude Protein	6.99	7.60
N.-free Extract	45.33	49.29
Total Nitrogen	1.12	1.22
Albuminoid Nitrogen	.89	.97

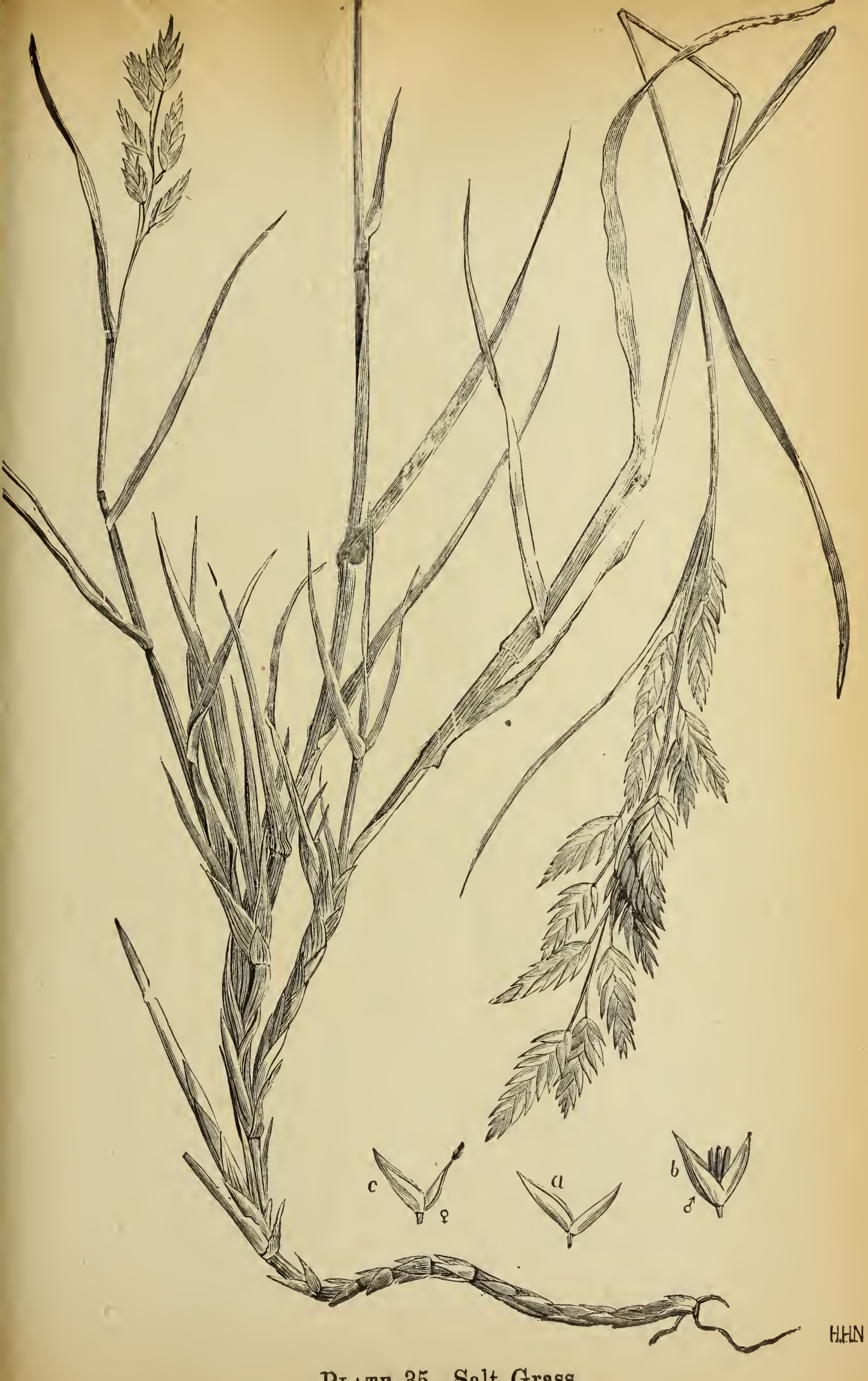


Plate 35—Salt Grass.

ORCHARD GRASS.

(*Dactylis glomerata* L.)

Stems erect, tufted, rough, two to three and one-half feet high, from tough, perennial, fibrous roots, leafy; leaves flat and broad, often eighteen inches long, rough on both sides, light green, often glaucous; panicle composed of compact clusters of flowers, the lower branches spreading, the upper ones short and crowded; spikelets three to four flowered, pale green, about one-fourth of an inch long, on short, rough stalks. Plate 36.

Orchard grass is a native of the Old World where it is a great favorite as a forage plant. It is also very highly prized in the eastern states. It makes a strong, rank growth, starts early in the spring, stands drouth better than timothy, gives rather a heavier yield, and is not so hard on the soil. As it ripens about the same time as clover, the two make an excellent mixture for hay. Orchard grass is readily eaten by all kinds of stock, sheep being particularly fond of it. The seed grows readily and should be sown thickly as the grass has a tendency to grow in clumps if thin on the ground. For this reason it is best to sow it in connection with clover or with other grasses. Under proper condition this grass has a long season of growth yielding a larger amount of forage throughout the year than most other common grasses. It should be cut while in bloom and when in pasture should be grazed closely and not allowed to seed very much. The specimens analyzed were cut on the College grounds on the 30th of June, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	5.51	——
Ash	10.00	10.58
Ether Extract	4.91	5.20
Crude Fibre	25.84	27.34
Crude Protein	13.78	14.58
N.-free Extract	39.96	42.29
Total Nitrogen	2.21	2.33
Albuminoid Nitrogen	1.56	1.67

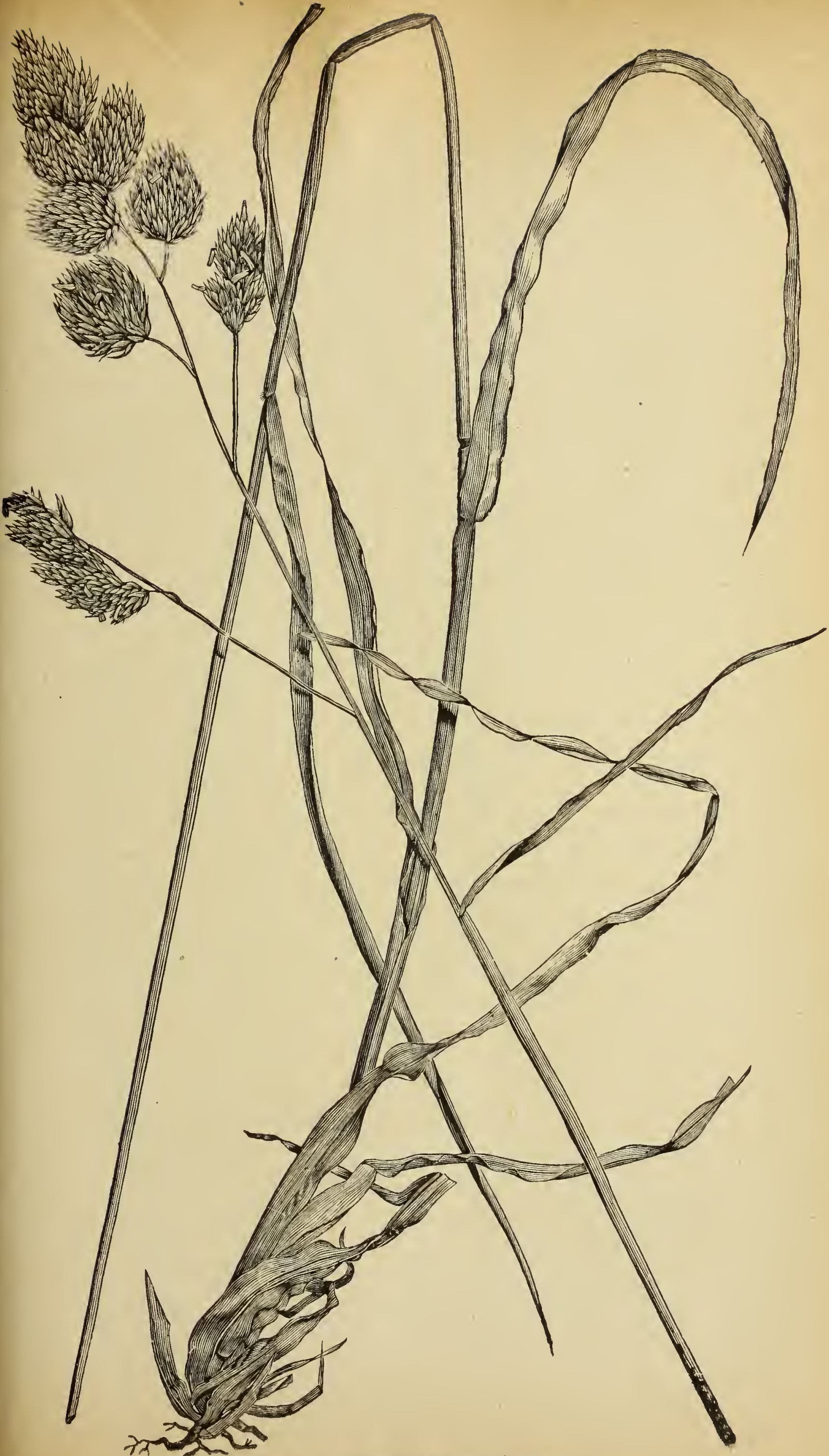


Plate 36—Orchard Grass.

FALSE RED TOP OR FOWL MEADOW GRASS.

(*Poa palustris* L.)

Stems erect, tufted, one and one-half to three feet high, from perennial, fibrous roots, leafy; leaves narrow, three to six inches long, smooth, soft; ligule elongated; panicle large, oblong, five inches to one foot long, often nodding, the branches rather short and rough; spikelets small, green or purplish, two to four flowered; empty glumes narrow; flowering glume faintly nerved. Plate 37.

Fowl meadow grass is quite plentiful in low native meadows in the eastern part of the state. It also occurs in the Black Hills, but is found but rarely in the central regions. It affords an abundance of forage of a superior quality. In the eastern states this grass is valued very highly. It does not make a dense sod like that of Kentucky blue grass, hence is most satisfactory when used in mixtures. Seed is produced in abundance and catches readily making the grass an easy one to propagate. It is an excellent grass for meadows that are occasionally overflowed. Unlike many of our grasses it does not become harsh and woody as soon as the seeds are ripened, but remains so soft, pliable and nutritious that stock will eat it without waste. It does well under cultivation on suitable soil and is worthy of trial by all who are trying to establish good meadows. The specimens analyzed were cut on the College farm, July 15th, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.55	——
Ash	7.39	7.99
Ether Extract	2.50	2.70
Crude Fibre	30.20	32.67
Crude Protein	8.69	9.40
N.-free Extract	43.67	47.24
Total Nitrogen	1.39	1.50
Albuminoid Nitrogen	1.17	1.26

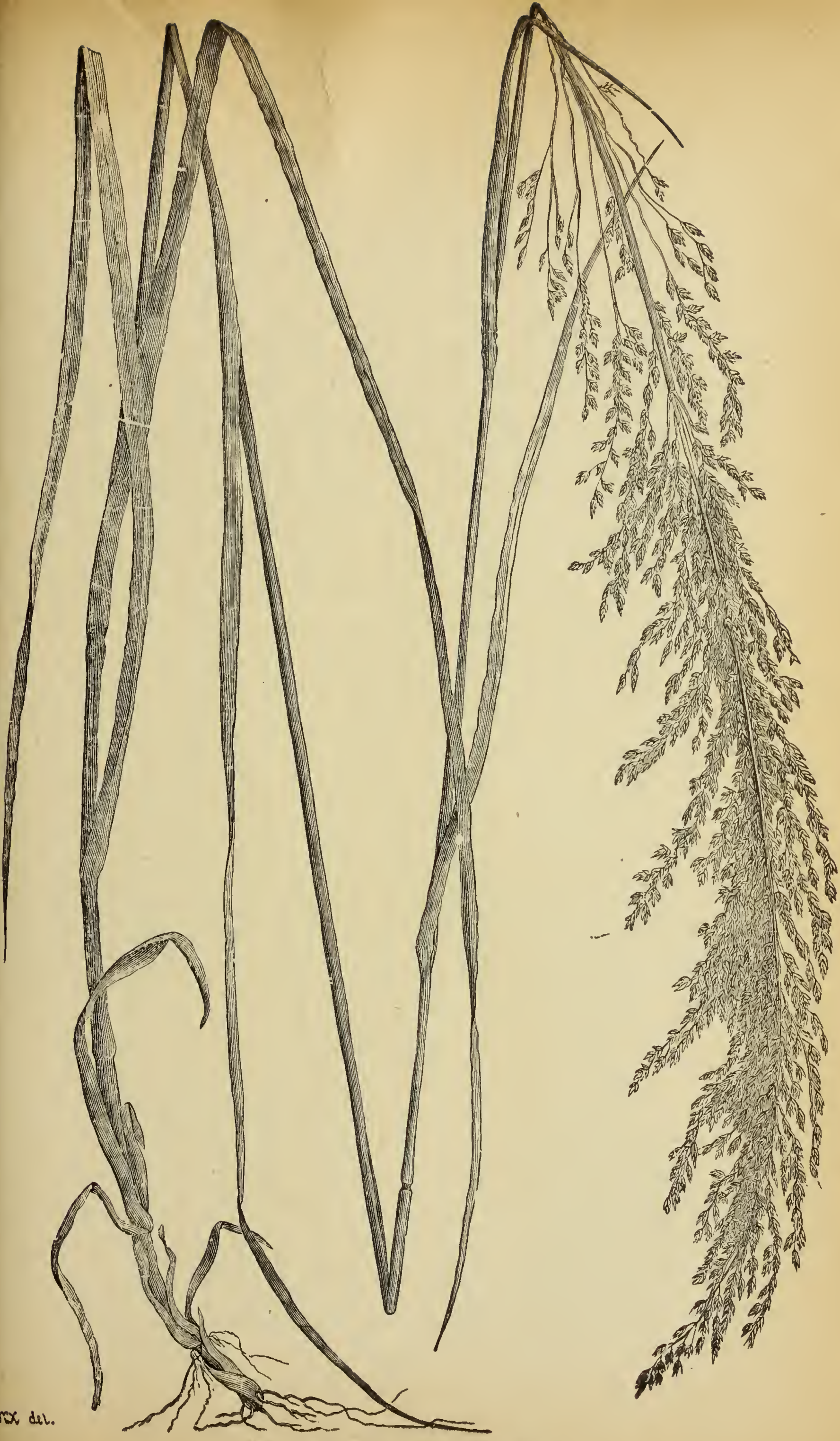


PLATE 37—False Red-Top.

KENTUCKY BLUE GRASS.

(*Poa pratensis* L.)

Stems erect, smooth, tufted at first, but spreading rapidly by means of the strong, creeping, root-stocks and at length forming a firm even sod, usually from one to three feet high; perennial; root-leaves long, narrow, flattish, channeled, smooth, rough on the margins, rather abruptly pointed; stem-leaves short, otherwise like the root-leaves; ligule short and blunt; panicle pyramidal, usually three or four inches long, open; spikelets rather small, three to five flowered; flowering glumes distinctly five-nerved, hairy below. Plate 38.

This is one of the best pasture grasses grown in the United States. It usually thrives on almost any soil. It is not so good for hay as the heavier, ranker growing grasses. It is the basis of all lawn mixtures because of its hardiness and because of its ability to crowd out weeds and form a dense sod. All kinds of stock eat it greedily. It is very nutritious and in time of drouth it dries retaining its nourishing properties, hence is still readily eaten by stock. It has done well on the College grounds as well as in many other parts of the state. It does not do so well on very dry, sandy, soils. Old, worn out pastures may often be reclaimed by being sown to blue grass. It makes an excellent sheep pasture, particularly when mixed with smaller fescues. The specimens analyzed were cut from the experimental plats on the College farm on the 7th of July, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.70	——
Ash	7.17	7.77
Ether Extract	2.93	3.17
Crude Fibre	31.74	34.39
Crude Protein	7.65	8.29
N.-free Extract	42.81	46.38
Total Nitrogen	1.23	1.33
Albuminoid Nitrogen	1.23	1.33

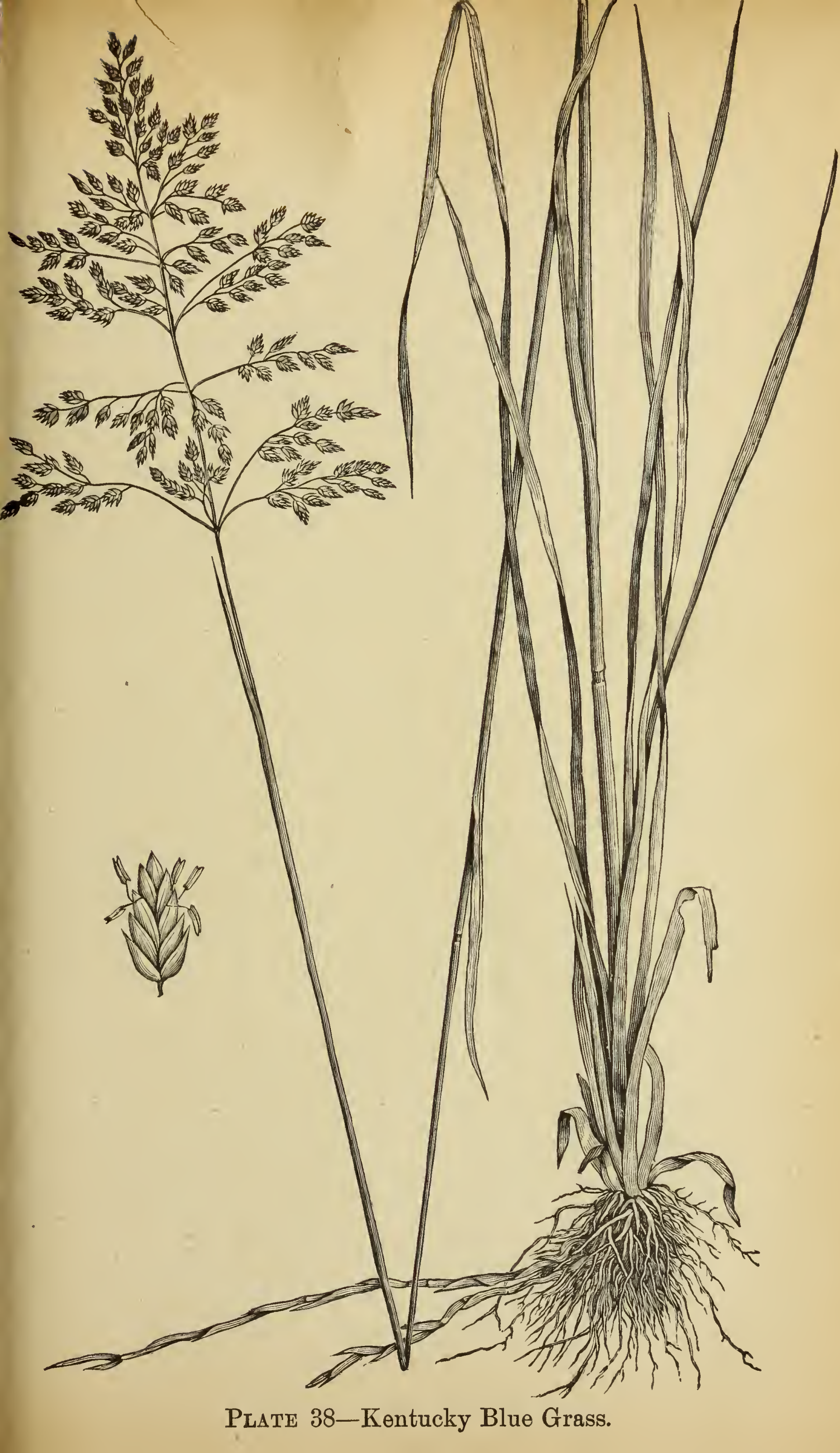


Plate 38—Kentucky Blue Grass.

CREEPING SPEAR-GRASS, ENGLISH BLUE GRASS OR WIRE GRASS.

(*Poa compressa* L.)

Stems flattened, bent below, then upright, usually a foot to eighteen inches high, rigid and wiry, from tough, perennial, running root-stocks; leaves short and narrow, rigid, bluish green; panicle short and narrow, one to three inches long, rather dense; spikelets very short stalked, flat, three to ten flowered; flowering glumes only slightly hairy on the margins and keel. Plate 39.

This is often found in cultivation as an introduced grass but is also found in many parts of the state growing naturally. It may be readily recognized by its flat stems and creeping habit. It is very hardy and makes a good pasture but does not yield as well as Kentucky blue grass. It thrives well on soil so poor that few other grasses would live upon it at all. Stock eats it readily and does well upon it. It is not so good for the lawn as Kentucky blue grass because it does not make a good growth of root leaves. It is perfectly hardy and is very persistent. The specimens analyzed were cut from the experimental plats on the Station grounds on the 13th of July, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.47	——
Ash	5.37	5.74
Ether Extract	2.78	2.97
Crude Fibre	31.55	33.73
Crude Protein	6.78	7.25
N.-free Extract	47.05	50.31
Total Nitrogen	1.09	1.16
Albuminoid Nitrogen	.95	1.01

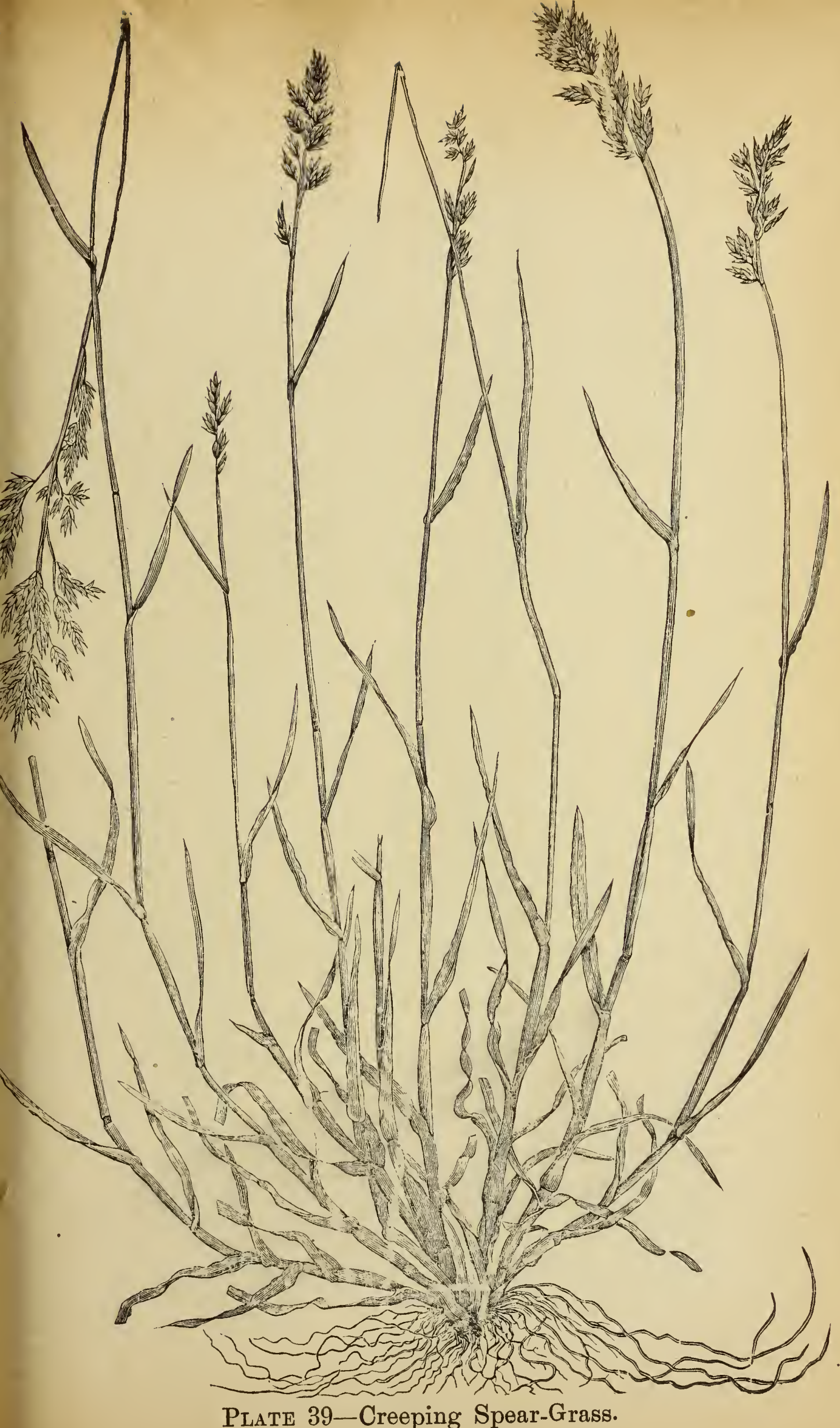


Plate 39—Creeping Spear-Grass.

BUNCH SPEAR GRASS.

(*Poa arida* Vasey *in litt.*)

Stems slender, erect, densely tufted, rather rigid, usually eight inches to two feet high, smooth; perennial; root-leaves rather numerous, pointed, flattish, about half as long as the stem; stem leaves seldom more than two, short, rigid and pointed, the blade of the upper one often less than one-half of an inch long; panicle narrow, rather dense, usually one to three inches long; spikelets rather large, three to seven flowered, usually tinged with purple; empty glumes acute; flowering glume obscurely nerved, hairy on the back and on the margins, with a broad, dry, thin, obtuse apex. Plate 40. (Our specimens have more root-leaves than are shown in the illustration.)

This grass seems to be quite generally distributed throughout the state, though it is apparently most plentiful in the eastern part. It occurs in dry meadows and in the Sioux Valley it is often plentiful enough to afford considerable forage. It has something of the appearance of Kentucky blue grass but is generally smaller, with smaller panicle, shorter leaves, and without the strong, creeping root-stocks of that species. It seems to be worthy of more trial under cultivation. The specimens analyzed were cut on a native meadow, near Brookings, July 6th, 1892. This is the *Poa andina* of Nuttall and American authors generally but not that of Trinius which is a Chilian species.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.10	——
Ash	8.80	9.47
Ether Extract	2.17	2.34
Crude Fibre	34.63	37.28
Crude Protein	4.88	5.25
N.-free Extract	42.42	45.66
Total Nitrogen	.78	.84
Albuminoid Nitrogen	.78	.84

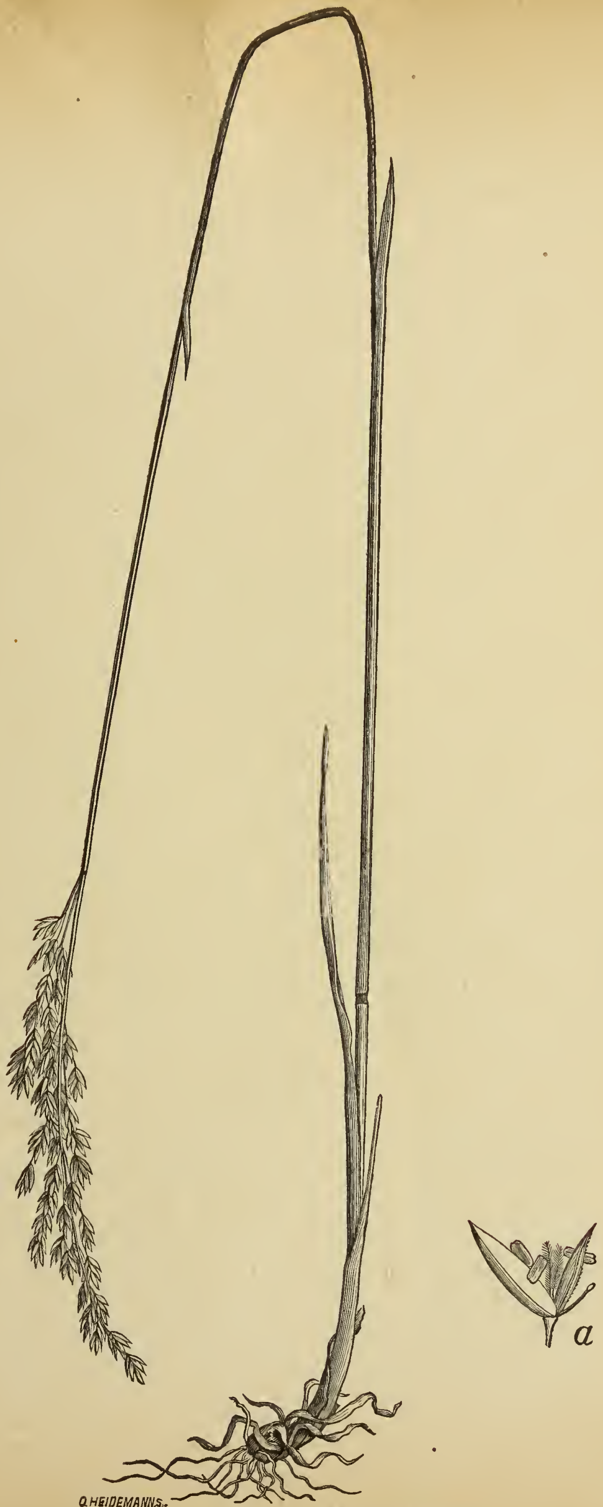


PLATE 40—Bunch Spear Grass.

WOOD MEADOW GRASS.

(*Poa nemoralis* L.)

Stems slender, erect, tufted, rigid, roughish, twelve to twenty inches high, from perennial, fibrous roots; leaves rather short, narrow, flattish or soon becoming rolled, rough; ligule short; panicle contracted, about three inches long, the branches very rough; spikelets very small, two to five flowered, usually purplish; empty glumes sharp-pointed; flowering glume hairy on the margins and keel, and rather obtusely pointed.

This grass is more or less common in rather moist woodlands throughout the state. It is quite abundant in the Sioux Valley, in the Black Hills, and in some localities along the James Valley. It sometimes yields considerable forage, particularly in wood-land pastures. The specimens analyzed were collected at Lake Hendricks the 1st of August, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	5.92	——
Ash	9.63	10.24
Ether Extract	2.27	2.41
Crude Fibre	27.75	29.50
Crude Protein	7.40	7.87
N.-free Extract	47.03	49.99
Total Nitrogen	1.18	1.26
Albuminoid Nitrogen	.87	.93

FLOATING MEADOW GRASS.

(*Panicularia fluitans* (L.) O. K.)

Stem smooth, upright, from a creeping, rooting base, two to four feet long; roots perennial; leaves six inches to a foot or more in length, roughish; panicle narrow, about one foot long, with simple, appressed branches; spikelets not numerous, seven to thirteen flowered, linear, one-half to one inch long, greenish; flowering glume oblong, obtuse or somewhat pointed, entire or sometimes toothed.

This grass occurs quite frequently in the Sioux Valley but has not, as yet, been found elsewhere in the state. It grows only in very wet and muddy places or in shallow water. It is readily eaten by stock but is not plentiful enough to be of much importance as a forage. It could be profitably grown in wet, boggy pastures and is a valuable grass in game preserves being a favorite food of all kinds of water-fowl. The specimens analyzed were cut from sloughs in pastures on the College farm on the 10th of July, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	5.05	——
Ash	8.39	8.84
Ether Extract	1.72	1.81
Crude Fibre	29.36	30.92
Crude Protein	8.60	9.06
N.-free Extract	46.88	49.37
Total Nitrogen	1.38	1.45
Albuminoid Nitrogen	1.28	1.34

FOWL MEADOW GRASS OR NERVED MANNA GRASS.

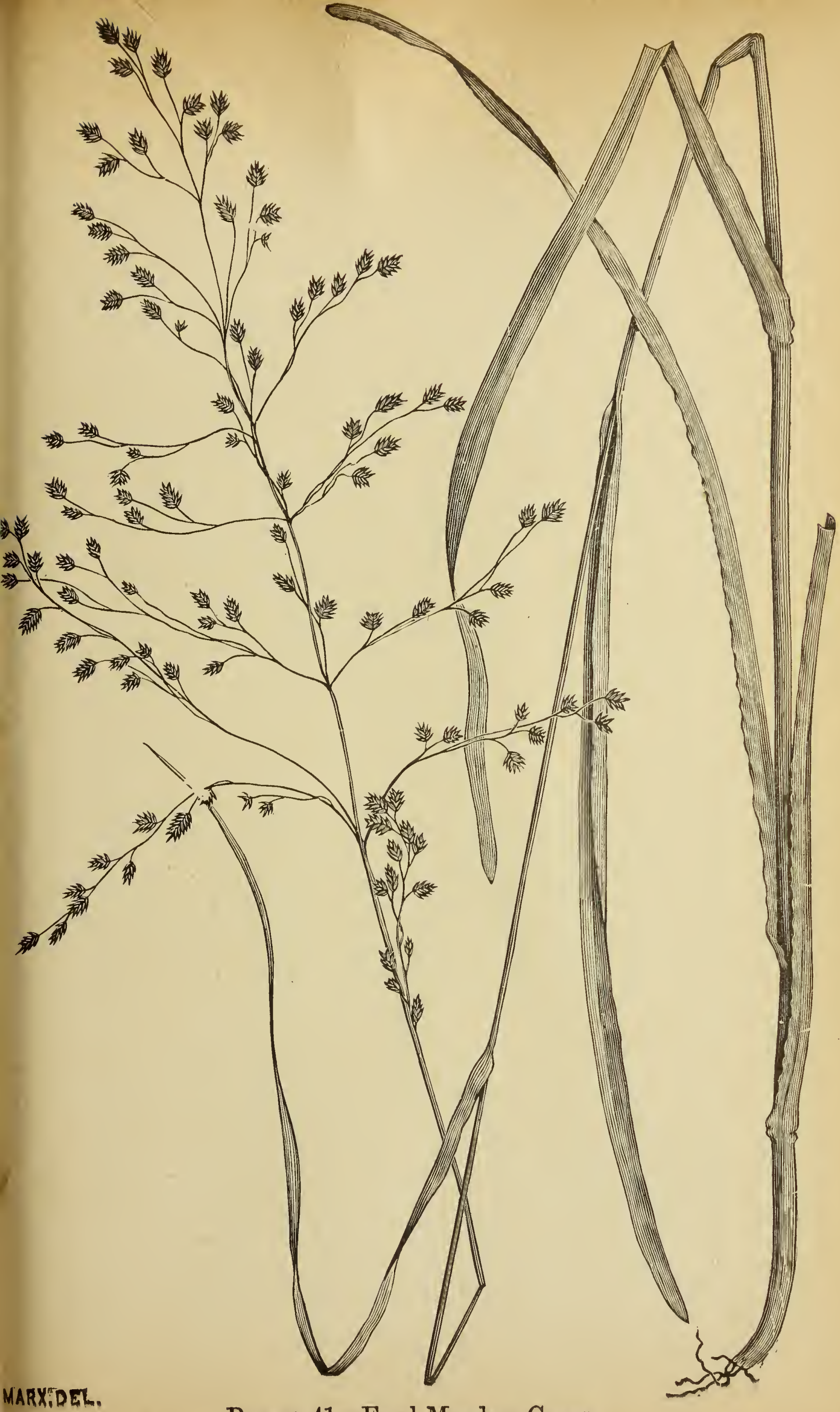
(*Panicularia nervata* (Willd.) O. K.)

Stems erect, smooth, eight inches to three feet high, from perennial, fibrous roots, often sending out a number of offshoots near the base, leafy; leaves roughish, usually flat, three inches to one foot in length; sheaths closed, rough; panicle four to eight inches long, loose, the branches slender and capillary and at length spreading and drooping; spikelets three to seven flowered, small, either green or purplish; flowering glume strongly seven nerved, more or less pointed. Plate 41.

This is a common grass in low, wet meadows, found generally throughout the state. In the more favored localities it often becomes plentiful enough to yield a large amount of forage. The quality of both hay and pasturage is excellent. In many parts of the United States this grass is thought to be of great value for use in moist pastures and meadows. It has been cultivated in England with good success. It would be a good grass to use in reclaiming some of our lake beds. The specimens analyzed were collected in the College pastures the 1st of July, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.64	——
Ash	8.69	9.31
Ether Extract	2.12	2.27
Crude Fibre	31.25	33.47
Crude Protein	4.32	4.63
N.-free Extract	46.98	50.31
Total Nitrogen	.69	.74
Albuminoid Nitrogen	.61	.65



MARX, DEL.

Plate 41—Fowl Meadow Grass.

REED MEADOW GRASS.

(*Panicularia americana* (Torr.) MacM.)

Stems robust, erect, smooth, three to five feet high, from perennial roots; leaves large (often as much as two feet long and one-half of an inch wide), smooth beneath and rough on the upper side and on the margins; panicle very large, about one foot long, usually purplish, much branched, the branches more or less spreading; spikelets numerous, three to six flowered; flowering glume seven nerved, not toothed at the tip. Plate 42.

Rather a coarse grass occurring throughout the state in shallow water or in very wet soil. It often furnishes a considerable amount of forage in low, boggy meadows. It is readily eaten by stock and is useful in reclaiming sloughs and old lake beds. It is quite abundant in the Sioux Valley. The specimens analyzed were cut on the College farm June 30th, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.71	——
Ash	8.74	9.47
Fther Extract	1.71	1.85
Crude Fibre	31.54	34.18
Crude Protein	7.92	8.58
N.-free Extract	42.38	45.92
Total Nitrogen	1.27	1.37
Albuminoid Nitrogen	.98	1.07

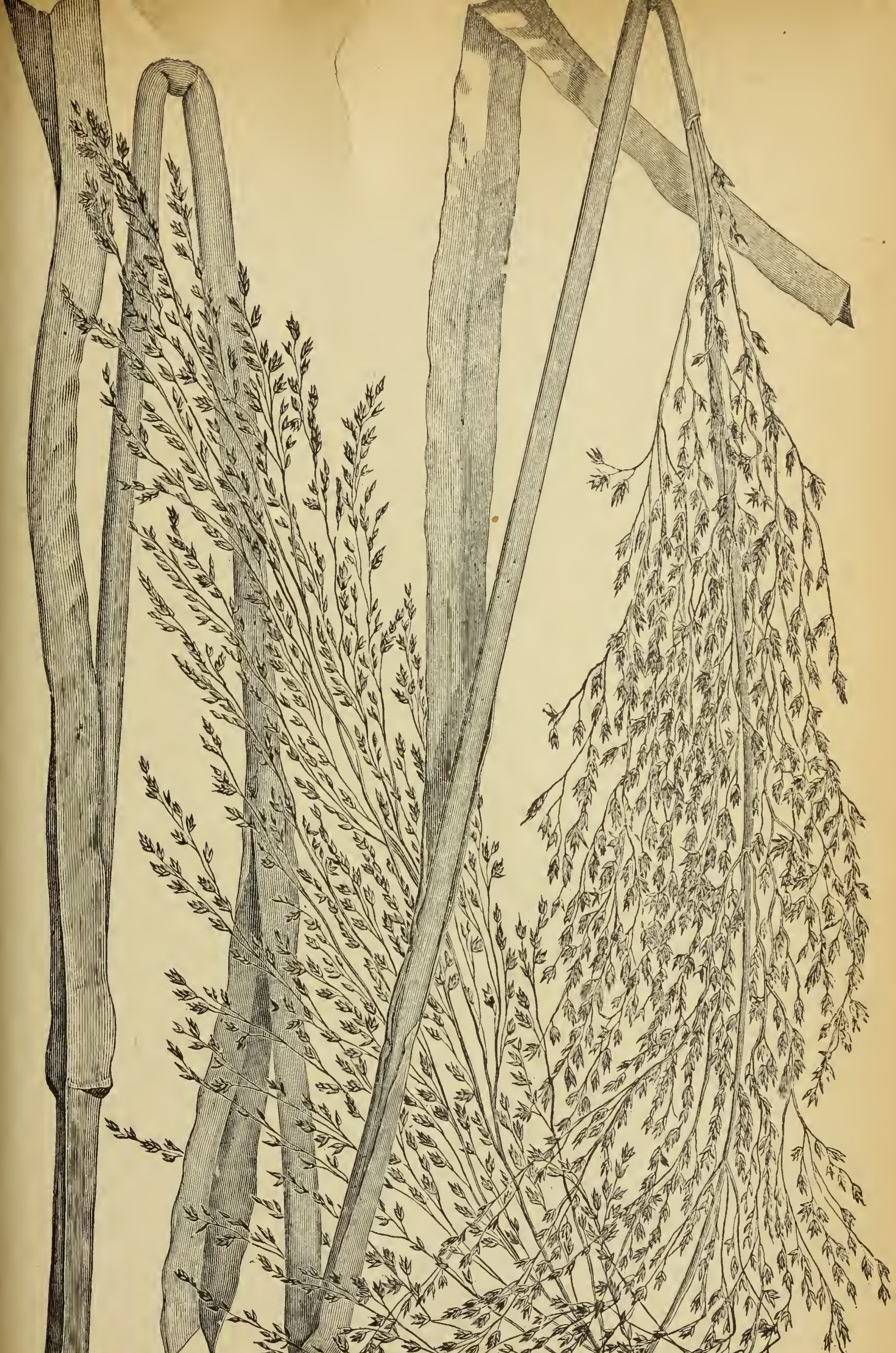


Plate 42—Reed Meadow Grass.

SHEEP'S FESCUE.

(*Festuca ovina* L.)

Stems slender, densely tufted, erect, six to eighteen inches high, from tough, perennial, fibrous roots; leaves short, narrow, usually rolled, sharp-pointed, very thickly clustered at the base of the stem; whole plant more or less glaucous; panicle short (one to three inches), narrow, rather one sided; spikelets three to eight flowered (usually about five flowered), one-fourth to one-half an inch long; flowering glume roughish, usually with a short awn. Plate 43.

Some forms of this grass are native to the state as well as to other parts of the United States but the common cultivated forms are introduced. It is one of the most valuable pasture grasses that has been tried on the Station grounds. It is perfectly hardy and is particularly well adapted to dry upland pastures, thriving on rocky and sandy soils. It is most useful as a sheep forage. The flowers open in June and July and the seeds soon ripen but the leaves remain green and fresh until late in autumn. The specimens analyzed were cut on the College grounds on the 2nd of June, 1891, and were then in bloom.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.41	——
Ash	6.74	7.28
Ether Extract	2.83	3.06
Crude Fibre	33.13	35.78
Crude Protein	5.96	6.44
N.-free Extract	43.93	47.45
Total Nitrogen	.95	1.03
Albuminoid Nitrogen	.84	.91

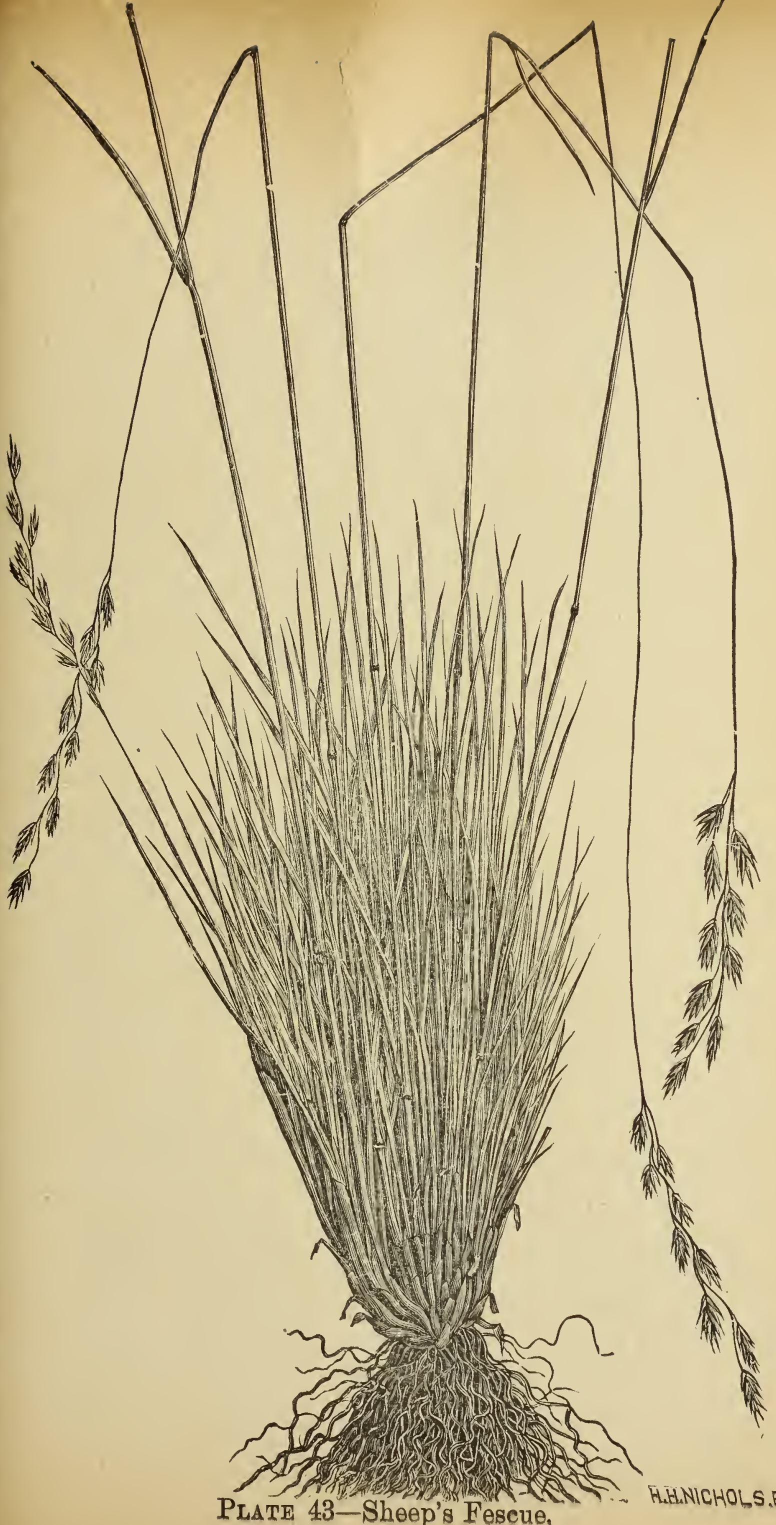


PLATE 43—Sheep's Fescue.

H.H.NICHOLS.EN

TALL FESCUE.

(*Festuca elatior* L.)

Stems stout, erect, smooth, two to four feet high; roots perennial, fibrous or sometimes creeping; leaves large (six inches to a foot or more long) flat, pointed; panicle six to ten inches long, rather narrow, contracted, except during flowering, erect, somewhat one sided, with short branches; spikelets five to ten flowered, crowded, lanceolate, about half an inch long; flowering glume five nerved, either with or without short awn. Plate 44.

Tall fescue is an extremely variable grass, a native of the Old World which has been widely introduced into the United States. Throughout the Eastern and Southern States it is regarded as a very valuable grass. Besides the common form there are two others ordinarily found under cultivation. One of these is smaller than the type and is known as "Meadow fescue" (*Festuca pratensis*); the other is larger than the type and may be known as "Tall meadow fescue" (*Festuca elatior arundinacea*). On the Station grounds both meadow fescue and tall meadow fescue have proven of more value than tall fescue, and of the two the first is perhaps to be preferred. These fescues do best with us on low moist soil though in the East and South they thrive on all kinds of soil. They are very largely used in the South for winter grazing and are often called "Evergreen grass." They may be used in our state in meadow and pasture mixtures for the richer, moister soils. The specimens analyzed belong to tall fescue and were cut from the experimental plats on the Station grounds on the 30th of June, 1891, while in bloom.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.22	——
Ash	7.48	8.15
Ether Extract	1.66	1.81
Crude Fibre	29.95	32.63
Crude Protein	6.82	7.43
N.-free Extract	45.87	49.98
Total Nitrogen	1.09	1.19
Albuminoid Nitrogen	1.00	1.10

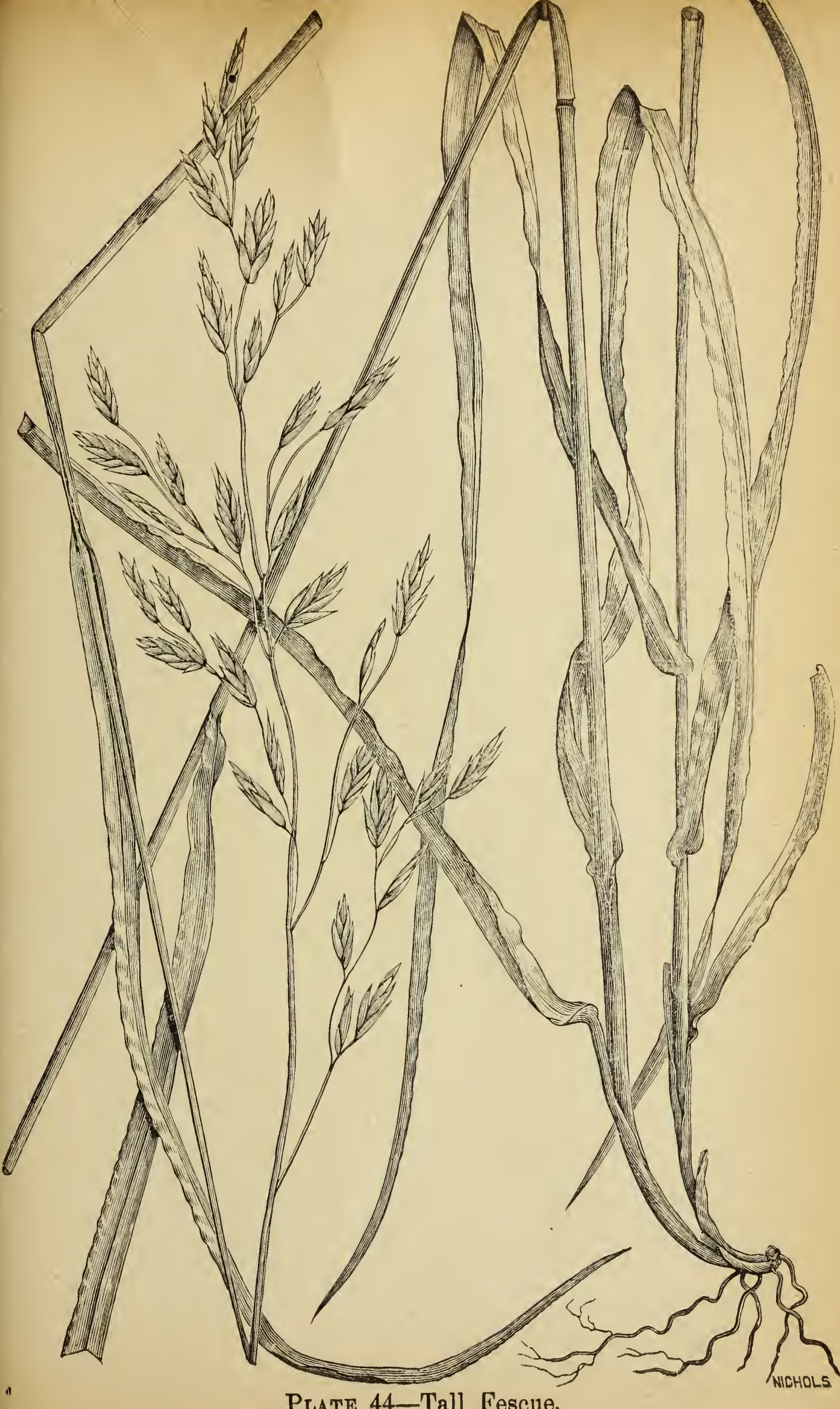


PLATE 44—Tall Fescue.

HARD FESCUE.

(*Festuca duriuscula* L.)

Similar to sheep's fescue but with larger, taller stems (one to two feet high); larger, more open panicles, flat leaves, usually hairy sheaths, larger spikelets and more numerous flowers. The plants are also less densely tufted and generally have a harsher feeling. Usually regarded as a variety of the preceding.

This fescue is occasionally cultivated and is probably also indigenous to some parts of the state. It forms a better sod than the sheep's fescue and is perhaps to be preferred as a general forage plant. Red fescue (*Festuca rubra* L.) is very similar to this grass and like it forms an evener sod than sheep's fescue. It grows about the same size as hard fescue and may be distinguished from both that and sheep's fescue by its habit of spreading by slender creeping root-stocks, and by its generally more grayish color (often tinged with red). Both of these grasses have been grown along with sheep's fescue and are perfectly hardy. They will be useful in dry pastures. The specimens of hard fescue analyzed were cut from the experimental plats on the Station grounds the 1st of June, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	5.95	——
Ash	8.36	8.89
Ether Extract	1.85	1.97
Crude Fibre	32.58	34.64
Crude Protein	8.12	8.63
N.-free Extract	43.14	45.87
Total Nitrogen	1.30	1.38
Albuminoid	.97	1.03

SOFT CHESS.

(*Bromus mollis* L.)

Stems erect or bent at the lower joints, tufted, smooth or hairy where not covered by the sheath, one to two feet high, from biennial, fibrous roots; leaves numerous, both blades and sheaths more or less densely soft-hairy; panicle rather erect, contracted in fruit, three or four inches long, the branches short causing the spikelets to be more or less clustered; spikelets five to ten flowered, ovate, flattish, downy, one-half to three-fourths of an inch long; flowers closely imbricated; lower empty glume three nerved, the upper five nerved; flowering glume acute, seven to nine nerved, equalling its spreading awn.

Soft chess is a native of the Old World which is occasionally introduced, usually in the seeds of small grain or other grasses. It may be recognized by the soft, downy character of the whole plant and by its contracted panicle. It seems perfectly hardy and may prove to be of considerable value as a forage. In many parts of the East it is regarded as a troublesome weed and hence should be handled with care. The sample intended for analysis was lost. The analysis, probably, would not vary widely from that of an undetermined species of brome grass which follows:

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.86	——
Ash	7.62	8.36
Ether Extract	2.03	2.23
Crude Fibre	28.34	31.10
Crude Protein	6.82	7.48
N.-free Extract	46.33	50.83
Total Nitrogen	1.09	1.20
Albuminoid Nitrogen	1.03	1.13

ROUGH BROME GRASS.

(*Bromus asper* L?)

Stems erect, slender, rough or smooth, from one to two or more feet high, from perennial fibrous roots; leaves linear-lanceolate, rather long, pointed, rough, often with long spreading hairs; sheaths nerved, more or less hairy; panicle small; spikelets five to nine flowered, about an inch long; lower empty glume one nerved, upper three nerved; flowering glume rather indistinctly five nerved, acute with an awn shorter than itself; flowers not crowded.

This grass was introduced in other grass seed. It does not agree in all respects with the published descriptions of the European species but seems to come nearer to it than to anything else. It is very hardy and yields a large amount of forage. The growth of root-leaves is abundant, affording excellent pasturage. The grass will bear further experimentation. The specimens analyzed were cut May 20th, 1891, on the experimental plats on the College farm where it formed an excellent mixture with tall oat grass.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.33	——
Ash	8.90	9.71
Ether Extract	3.26	3.56
Crude Fibre	29.01	31.65
Crude Protein	8.98	9.80
N.-free Extract	41.52	45.29
Total Nitrogen	1.44	1.57
Albuminoid Nitrogen	1.20	1.31

SWAMP CHESS.

(*Bromus ciliatus* L.)

Stem stout, erect, smooth or somewhat hairy, three to five feet high, from perennial fibrous roots; leaves large (six to ten inches long and one-fourth to one-half of an inch wide), flat, smooth or some what hairy (especially on the sheaths); panicle large and compound, loose, the branches spreading and drooping; spikelets loosely seven to twelve flowered, one-half to three-fourths of an inch long; lower empty glume one nerved, the upper three-nerved; flowering glume seven nerved, silky hairy near the margins, longer than its awn.

This grass is quite common along river banks and in moist woods, occurring throughout the state but perhaps more plentiful in the Sioux Valley and Big Stone region. It is quite variable, being nearly smooth in the common form or quite uniformly hairy in variety *purgans.* Though so widely distributed it is of very little agricultural value. The specimens analyzed were collected near White on the 17th of August, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.73	———
Ash	8.00	8.77
Ether Extract	3.00	3.29
Crude Fibre	30.75	33.69
Crude Protein	7.75	8.49
N.-free Extract	41.77	45.76
Total Nitrogen	1.24	1.36
Albuminoid Nitrogen	.92	1.01

SMOOTH BROME GRASS.

(*Bromus inermis* L.)

Stems erect, robust, smooth, one and one-half to four feet high, from slender, perennial, creeping root-stocks and fibrous roots, leafy; leaves large, six inches to a foot, or more long and one-fourth of an inch or often more in width, long-pointed, rough; panicle erect or nodding, usually about eight inches long, rays simple or somewhat branched; spikelets five to ten flowered (usually about seven flowered), linear, usually an inch or more long; flowers loosely imbricated; flowering glume abtuse, seven nerved, awnless or rarely with a very minute awn. Plate 45.

This grass is a native of Europe and Asia. From the fact that it is said to have been introduced into this country from Austria and Hungary it is often called Austrian or Hungarian brome grass. It is easily distinguished from all other common brome grasses by its smooth, usually beardless glumes or "chaff." This is the best grass that has yet been tried at the Station. When properly sown it catches well, giving a good sod the first year; in favorable seasons a fair yield of hay may also be obtained. Up to the present, the best results have been obtained by sowing plenty of seed on well prepared ground as early as possible in the spring. From two to two and one-half bushels should be sown to the acre, depending somewhat upon the season and upon the condition of the soil. The forage, though coarse, is of excellent quality and under ordinary circumstances a large amount of early spring and fall feed may be obtained in addition to a good yield of hay. Thus far the grass has endured drouth perfectly and has never winter killed in the least. The specimens analyzed were cut from the experimental plats on the College farm, July 7th, 1892, and were then just going out of bloom.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.21	—
Ash	7.58	8.08
Ether Extract	1.93	2.06
Crude Fibre	38.71	41.27
Crude Protein	10.12	10.79
N.-free Extract	35.45	37.80
Total Nitrogen	1.62	1.73
Albuminoid Nitrogen	1.15	1.23

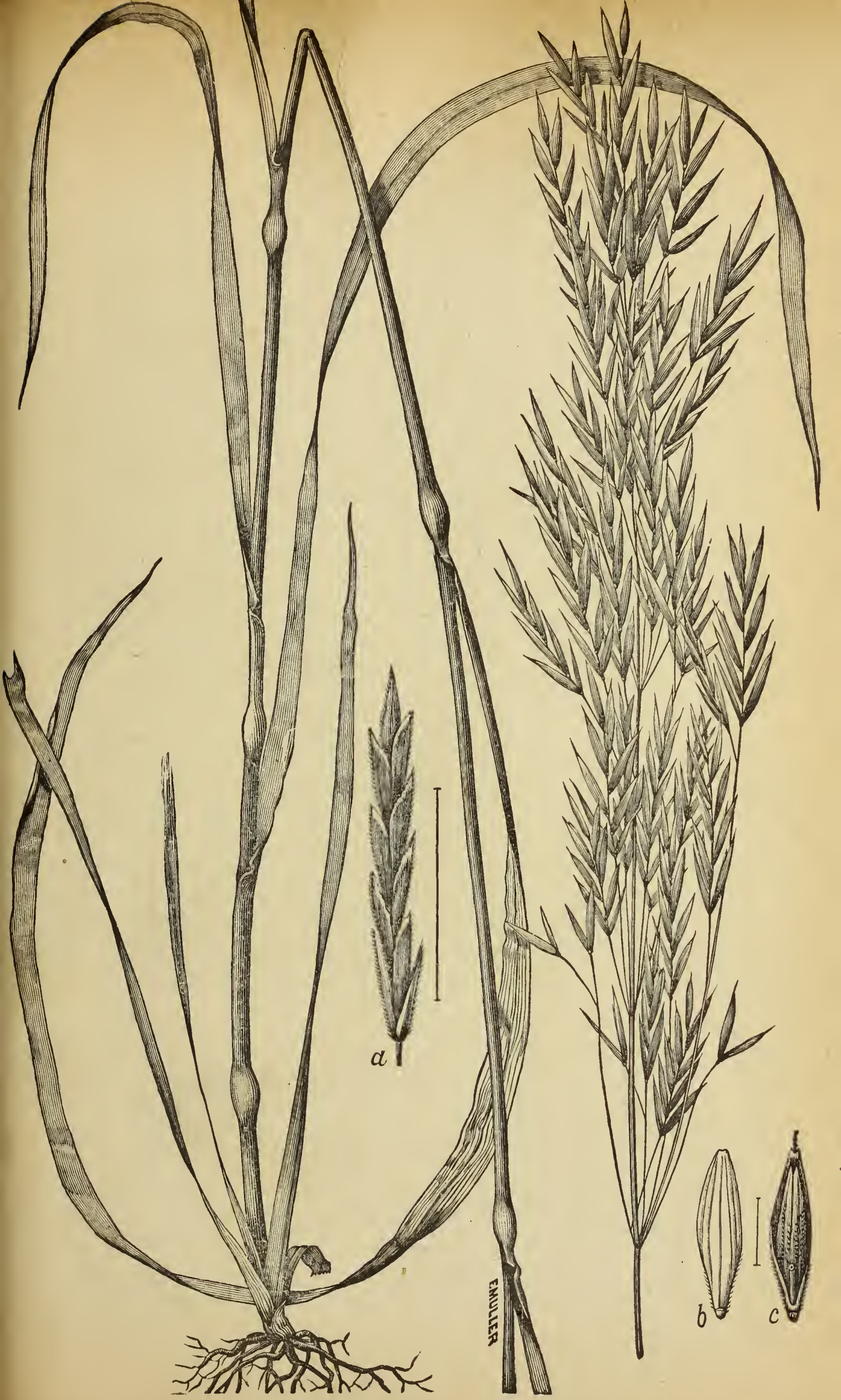


PLATE 45—Smooth Brome Grass.

SCHRADER'S BROME GRASS.

(*Bromus unioloides* Willd.)

Stems erect, smooth, six inches to three feet high, from annual fibrous roots, very leafy; leaves rather long and narrow, rough on the margins and more or less hairy on the sheaths; panicle open, the branches at length drooping; spikelets large (an inch or more long), broad and flat, six to ten flowered; flowering glumes large, many nerved, tapering into a very fine sharp point or short awn.

This is one of the so-called winter grasses of the South where it is considered to be very valuable. The name Rescue grass is sometimes applied to it. It produces a very nutritious, much relished forage. On the Station grounds it has not been a success, some years giving a fair yield, others producing scarcely any forage at all. The specimens analyzed were cut from the experimental plats on the College farm, July 9th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.13	——
Ash	9.03	9.72
Ether Extract	2.09	2.25
Crude Fibre	32.39	34.88
Crude Protein	9.97	10.74
N.-free Extract	39.39	42.41
Total Nitrogen	1.59	1.72
Albuminoid Nitrogen	1.35	1.45

SLENDER WHEAT GRASS.

(*Agropyrum tenerum* Vasey.)

Stems rather slender, erect or bent at the lower joints, tufted, smooth, one and one-half to four feet high, from perennial, fibrous roots, leafy; leaves flat, sharp-pointed, rough, three inches to one foot long; spike very slender, three to ten inches long, nodding; spikelets three to five flowered, a half inch or more long, closely appressed to the stem; empty glumes equal, conspicuously five to seven nerved, about as long as the entire spikelet, sharp-pointed; flowering glume rough, obscurely five nerved, with sharp point or awn.

Slender wheat grass is found more or less abundantly over the entire state. It prefers the moister lands of the bottoms along streams but also occurs on dry soils. It is one of the most promising native grasses grown on the Station grounds, improving rapidly under cultivation. On good, well tilled soil the yield is very heavy. The hay is of excellent quality. There is no danger of this grass ever becoming troublesome as a weed. It is not so valuable for pasturage as western wheat grass. It comes readily from the seed and may be sown either alone or in mixtures with other grasses. The seeds ripen in July. The specimens analyzed were cut on the College farm on the 1st of July, 1891, and were in bloom.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.78	—
Ash	5.29	5.74
Ether Extract	2.55	2.77
Crude Fibre	29.92	32.44
Crude Protein	8.21	8.90
N.-free Extract	46.25	50.15
Total Nitrogen	1.31	1.42
Albuminoid Nitrogen	1.15	1.24

QUACK GRASS, COUCH GRASS.

(*Agropyrum repens* (L.) Beauv.)

Stems usually robust, erect, green, two to three or even four feet high, from stout, strong growing, creeping root-stocks; leaves numerous, green, rather thin, flat, long and pointed; spike narrow, three to six inches long; spikelets about half an inch long, four to eight flowered, green, smooth, rather closely appressed to the stem; empty glumes five to seven nerved, tapering into a sharp-point or sometimes short-awned; flowering glume usually with an awn of variable length proceeding from its apex. Plate 46.

This is a perennial, weedy grass which possibly occurs throughout the state though it has, as yet, been found in the eastern part only. It is one of the worst pests that can be had in an orchard or in a tree claim. Its greener color, strongly nerved glumes, appressed spikelets, and stronger, creeping root-stocks will serve to distinguish it from the other closely related species. When cut in proper season it affords a very nutritious hay. It is readily eaten by all kinds of stock unless allowed to stand until it has become too dry and woody. The specimens analyzed were cut on the College farm on the 29th of June, 1891 and were then just coming into bloom.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.00	——
Ash	6.93	7.45
Ether Extract	1.93	2.07
Crude Fibre	33.02	35.51
Crude Protein	9.22	9.91
N.-free Extract	41.90	45.05
Total Nitrogen	1.48	1.59
Albuminoid Nitrogen	1.21	1.30

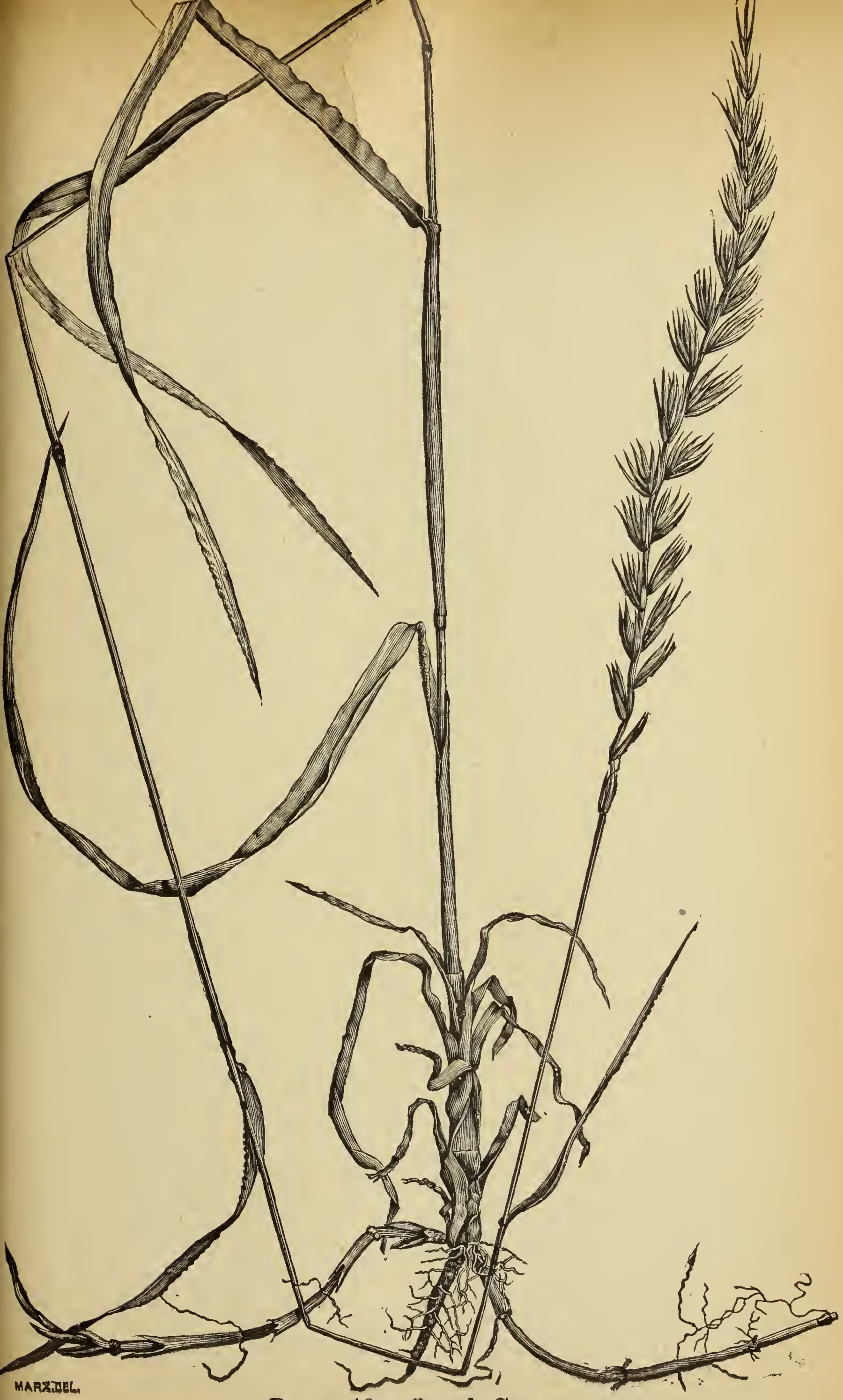


PLATE 46—Quack Grass.

WESTERN WHEAT GRASS.

(*Agropyrum glaucum occidentale* Scribn.)

Stem slender or robust, erect, smooth, one to three feet high, from slender creeping root-stocks; whole plant glaucous, green; leaves rather thick, rolled, four to eight inches long, not so numerous as in the preceding species; spike seldom more than four inches long, often with more than one spikelet at each joint, densely flowered; spikelets five to ten flowered, half an inch or more long; flowering glumes rather obscurely five nerved, narrowed into a sharp, short-awned point. Plate 47.

This is one of the commonest grasses in the state. It is particularly plentiful on the "range" and is the most important native forage plant throughout the greater portion of the state west of the Sioux Valley. It is very valuable both for pasturage and for hay. In many parts of the west it goes by the name of Colorado blue stem on account of its bluish or glaucous appearance. This character, together with its more rigid stem and leaves, shorter, more densely flowered spike and more slender root-stocks will serve to distinguish it from quack grass. If this grass is cut too closely for several years in succession the yield becomes lighter each year, particularly if very dry weather prevails. This trouble can be obviated in a large degree by allowing the meadow an occasional year of rest and by occasionally going over it with a short-toothed harrow. The dragging breaks up the creeping root-stocks and then each piece produces a new plant. The specimens analyzed were cut on the College farm on the 12th of August, 1892, and were just past blooming.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.22	——
Ash	7.82	8.52
Ether Extract	2.67	2.91
Crude Fibre	32.03	34.90
Crude Protein	8.99	9.80
N.-free Extract	40.27	43.88
Total Nitrogen	1.44	1.57
Albuminoid Nitrogen	1.18	1.29

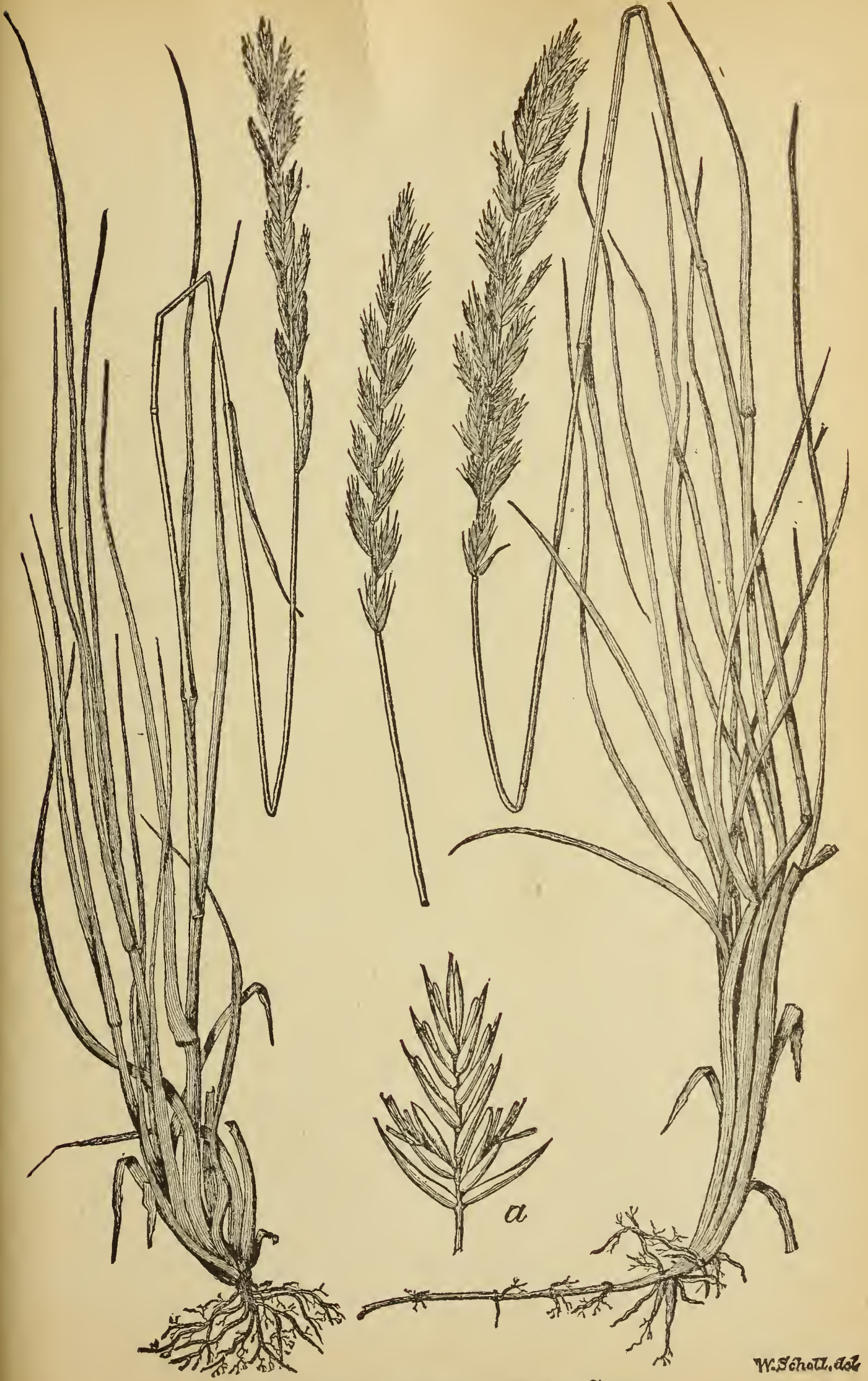


PLATE 47—Western Wheat Grass.

BEARDED WHEAT GRASS.

Aprogyrum caninum (L.) R. & S.)

Stems rather robust, upright or bent at the lower joints, smooth, from one and one-half to three feet high, from perennial, fibrous roots, leaves narrow, pointed, flat or somewhat rolled, rough and somewhat hairy above, smooth beneath; sheaths smooth; spike closely flowered, about five or six inches long, more or less nodding; spikelets three to five flowered; empty glumes five to seven nerved, sharp-pointed or with awns of variable length; flowering glume five nerved near the tip, awned.

This grass is quite common in the eastern part of the state. It does not agree in all respects with the species as found in the eastern United States, but approaches the next in many respects as also the western *agropyrum divergens* Nees. It often occurs in the meadows and hence is not infrequently found in hay but is probably the least valuable of all the wheat grasses found in the state. The specimens analyzed were collected on the College farm, July 18th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.09	——
Ash	8.00	8.52
Ether Extract	1.80	1.92
Crude Fibre	41.23	43.90
Crude Protein	4.67	4.97
N.-free Extract	38.21	40.69
Total Nitrogen	.75	.80
Albuminoid Nitrogen	.72	.77

BEARDED WHEAT GRASS.

(*Agropyrum unilaterale* Vasey and Scribner.)

Stems erect, sometimes bent at the lower joints, two to four feet high, from perennial fibrous root, leafy; leaves rather long, pointed, rough; spike somewhat one-sided, about six inches long, nodding; spikelets three to four flowered; empty glumes linear, very rough on the back, strongly four to six nerved, equalling or longer than their awns; flowering glume about six nerved above, two-toothed at the apex; awn from one to two inches long, rough and straight.

This is the commonest of the bearded wheat grasses and occurs throughout the state, usually on rather low, moist ground. It produces a good quality of hay and in some localities enters quite largely into the native forage. It may prove to be of value under cultivation. The specimens analyzed were cut near Brookings the last of July, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	5.30	——
Ash	7.34	7.75
Ether Extract	1.71	1.81
Crude Fibre	39.43	41.64
Crude Protein	5.75	6.07
N.-free Extract	40.47	42.74
Total Nitrogen	.92	.97
Albuminoid Nitrogen	.74	.78

PERENNIAL RYE GRASS.

(*Lolium perenne* L.)

Stems rather robust, erect or more or less bent at the lower joints, tufted, smooth, one and one-half to three or four feet high, from perennial, fibrous roots, very leafy; leaves narrow, flat, two to six inches long; sheaths smooth, nerved; spike erect, rigid, three to eight inches long; spikelets flat, about half an inch long, placed edgewise upon the zigzag axis of the spike, usually from one-fourth to one-half an inch apart, eight to fifteen flowered; flowering glume rather thick, obscurely nerved, sharp-pointed. Plate 48.

This grass is a native of the Old World which is extensively cultivated in many parts of the United States. In England it is regarded as one of the best hay grasses that can be grown. The variety known as Italian rye grass (*Lolium perenne italicum*) is the most valuable. It may be recognized by its greater growth of stem and leaves and by its bearded glumes. On the Station grounds Italian rye grass has done much better than perennial rye grass. It withstands the drouth of summer and gives a good yield of excellent hay, but it winter kills badly and hence can hardly be regarded as a success. Where irrigation can be had this grass would be well worth an extended trial. The specimens analyzed belong to this variety and were cut from the experimental plats on the College farm, August 8th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.56	——
Ash	10.91	11.93
Ether Extract	3.05	3.34
Crude Fibre	26.80	29.31
Crude Protein	13.36	14.61
N.-free Extract	37.32	40.81
Total Nitrogen	2.14	2.34
Albuminoid	1.59	1.74

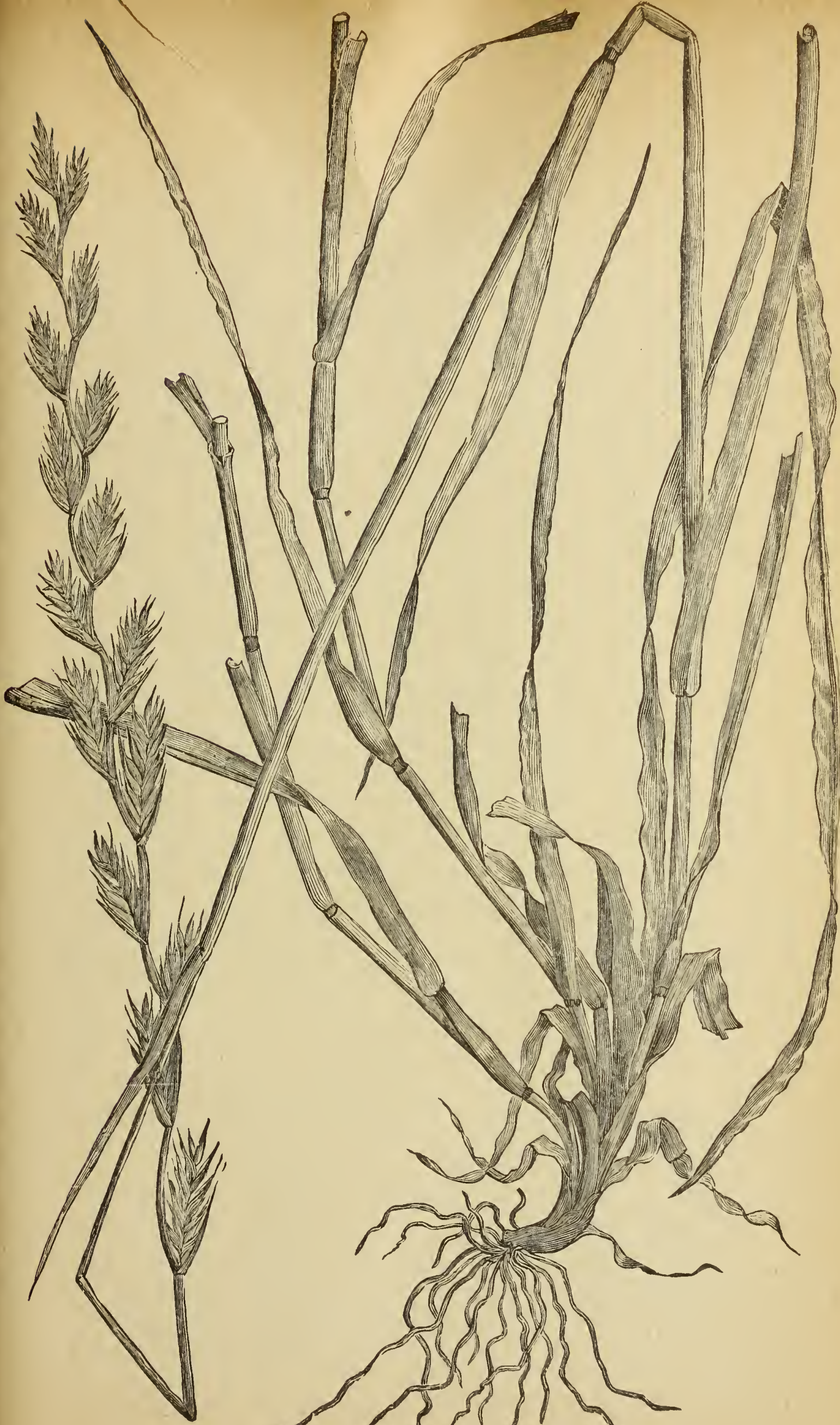


Plate 48—Perennial Rye Grass.

SQUIRREL-TAIL GRASS.

(*Hordeum jubatum* L.)

Stems erect, smooth, tufted, eight to eighteen inches high, from annual, fibrous roots, leaves flat with more or less roughened blades and smooth sheaths; spikes erect or nodding, shining, pale green, straw-colored or sometimes purplish, two to four inches long, awns or "beards" one to two or more inches long, spreading, giving the spike a bushy appearance—hence the common name—squirrel-tail grass.

This grass is found more or less plentifully throughout the state. It grows on all kinds of soil. Although eaten by stock while it is young squirrel-tail is regarded as a most obnoxious weed. The rough beards get into mouths, throats and eyes of animals, and into the wool of sheep often causing very bad sores. When ripe the spikes or heads break up into small sections or joints each piece bearing one or more of the spikelets with their cluster of awns or beards. These attach themselves to the clothing, work in deeper and deeper causing the wearer considerable discomfort. Moreover, this grass is often badly affected by the same rusts that trouble the small grains and hence may become a source of infection unless carefully burned in autumn. It is usually found in waste places and along roadsides. As it is only an annual it can be readily destroyed by thorough cultivation. The specimens analyzed were collected at Brookings the 1st of July, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	9.73	—
Ash	8.22	9.11
Ether Extract	2.59	2.87
Crude Fibre	28.66	31.75
Crude Protein	9.84	10.90
N.-free Extract	40.96	45.38
Total Nitrogren	1.58	1.74
Albuminoid Nitrogen	1.23	1.36

WILD RYE OR LYME GRASS.

(*Elymus virginicus* L.)

Stems robust, tufted, erect, or sometimes ascending, smooth, one and one-half to three feet high, from perennial, fibrous roots; leaves six inches to a foot or more long, broad, flat, rough; the upper sheath often enclosing the base of the spike; spike erect, rigid, dense, two to five inches long and usually about one-half an inch thick; spikelets in twos or threes, two to three flowered, smooth; empty glumes thick and coarse, strongly nerved, bristle-pointed; flowering glume with a stiff straight awn usually one-half to three-fourths of an inch long.

This grass is about as common as the preceding species, having about the same distribution and similar to it in value though perhaps more useful as a pasture grass. In many parts of the United States, particularly in the South, this grass is a very important forage plant. The specimens analyzed were collected at Brookings the 1st of July, 1891. What has been said regarding early cutting of the last species is equally applicable to this grass.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.29	——
Ash	7.60	8.31
Ether Extract	3.04	3.31
Crude Fibre	27.20	29.66
Crude Protein	6.63	7.23
N.-free Extract	47.24	51.51
Total Nitrogen	1.06	1.16
Albuminoid Nitrogen	.92	.99

WILD RYE.

(*Elymus canadensis* L.)

Stem robust, erect, tufted, smooth, two to four or five feet high, from perennial, creeping roots; leaves large, broad and flat, sometimes smoothish but usually roughened; sheaths smooth; spike large, four to nine inches long, nodding; spikelets mostly in twos, three to five flowered; empty glumes very narrow, tapering into a rough awn; flowering glumes five nerved, rough, hairy, with long, spreading, rough awn. Plate 49.

Wild rye is more or less plentiful in all parts of the state, growing mostly in the moister soil of the valleys. In many localities it constitutes a considerable part of the native forage. It is frequently cut for hay, furnishing a good yield of fair quality. Cutting should be done early to get the best quality of hay and also to avoid ergot which often occurs on this and related grasses. In wood-land and bottom pasturages wild rye is often one of the most important grasses, particularly for early grazing. A larger, glaucous form (var. *glaucifolius*) is found in many parts of the state. The specimens analyzed were collected at Brookings on the 2nd of July and were then in proper condition for hay.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.54	——
Ash	8.61	9.31
Ether Extract	1.64	1.77
Crude Fibre	34.16	36.95
Crude Protein	5.28	5.71
N.-free Extract	42.77	46.26
Total Nitrogen	.85	.91
Albuminoid Nitrogen	.59	.64

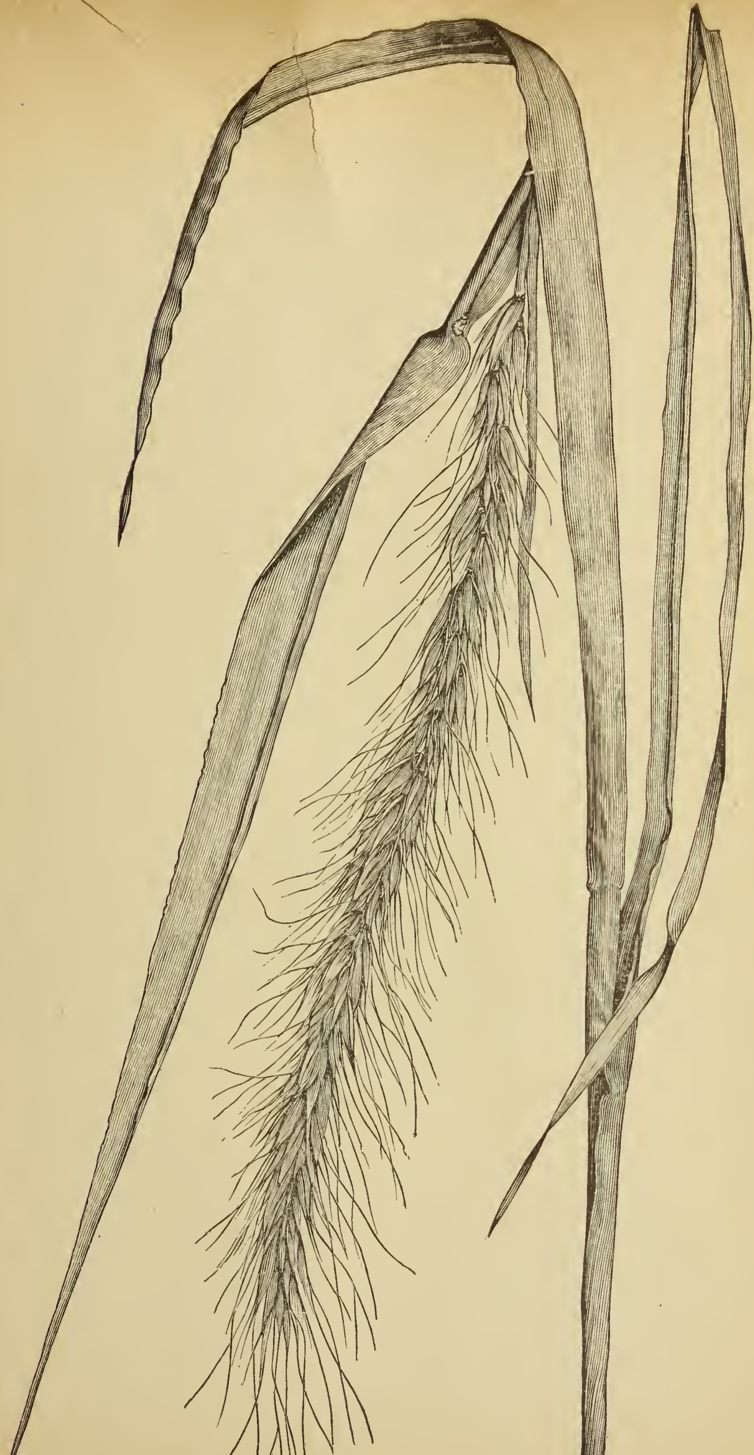


Plate 49—Wild Rye.

DENNETT GRASS.

(*Elymus striatus* Willd.)

Stems slender, tufted, upright, two to three feet high, from creeping, perennial roots; leaves rather thin, long, flat and roughish; spike rather slender but dense, more or less nodding, two to four inches long; spikelets usually in twos, one to two (rarely three) flowered; empty glumes very narrow, one to three nerved, with a long, bristle-like awn; flowering glume with a long capillary awn; whole plant more or less hairy.

This grass occurs throughout the eastern part of the state in rather dry or rocky woods. It is of little value for forage as it is too rare. It is very nutritious and is readily eaten by stock. It is difficult to save any seed as the spikelets drop off so easily. A form (var. *villosus*) with very hairy flowers and sheaths is occasionally found. The specimens analyzed were collected at Flandreau on the 12th of August, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.25	—
Ash	7.91	8.62
Ether Extract	2.55	2.78
Crude Fibre	27.83	30.33
Crude Protein	8.37	9.12
N.-free Extract	45.09	49.14
Total Nitrogen	1.34	1.46
Albuminoid Nitrogen	1.15	1.25

FLAT STEMMED TUFTED SPIKE-RUSH.

(*Eleocharis acuminata* (Muhl.) Nees.)

Stems flat, striate, tufted, erect, from perennial roots and root-stocks, one to two feet high, leafless; spikelets ovate, oblong to lanceolate, pointed, about half an inch long or less; scales acute, dark purple with broad pellucid white margins; achene obvate, pen-shaped, obtusely triangular, yellowish, wrinkled, crowned with a small, conical, pointed, tubercle equalling or longer than the usual one to four very slender, fragile bristles.

Apparently rarer than either of the two succeeding species; known thus far only from the Sioux Valley and the Black Hills regions. It probably occurs elsewhere in the state. It may be distinguished from the other species given by its flat stems and tufted habit of growth. Probably of little importance as a forage plant. The specimens analyzed were collected at Brookings, July, 1892.

ANALYSIS.

	Air Dry Substance	Water Free Substance.
Water	6.27	——
Ash	9.89	10.55
Ether Extract	2.24	2.39
Crude Fibre	30.60	32.65
Crude Protein	6.47	6.90
N.-free Extract	44.53	47 51
Total Nitrogen	1.04	1.11
Albuminoid Nitrogen	.85	.90

TUFTED SPIKE-RUSH.

(*Eleocharis obtusa* R. Br.)

Stems tufted, erect, eight inches to a foot and a half high, from annual, fibrous roots, nearly round, leafless; spikelets ovoid to ovate oblong, usually from one-fourth to one-half an inch long, obtuse, dull brown; scales very obtuse, densely crowded in many ranks, with a greenish keel and pale margins; achene much narrowed below, pale-brown, shining, with an acute flattened tubercle; bristles six to eight, longer than the achene.

Found quite commonly throughout the eastern half of the state in wet, muddy places and shallow water. Distinguished from the other spike-rushes by its large obtuse spikelets and its habit of growing in large tufts. Of little value for a forage plant except in places too wet for most other sedges or grasses. The specimens analyzed were collected near Bangor, Walworth county, September 1st, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.38	——
Ash	12.45	13.30
Ether Extract	2.56	2.73
Crude Fibre	27.53	29.41
Crude Protein	9.45	10.09
N.-free Extract	41.63	44.47
Total Nitrogen	1.51	1.62
Albuminoid	1.26	1.34

COMMON SPIKE-RUSH.

(*Eleocharis palustris* R. Br.)

Stems upright, terete, striate, usually slender, one to four feet high, more or less tufted, from perennial roots and running root-stocks; leaves none but represented by more or less well developed sheaths at the base of the stem; spikelet oblong, lanceolate, pointed; scales ovate, oblong, obtuse or the upper ones pointed, loosely imbricated, reddish brown with a greenish keel and broad, translucent, whitish margin; achene or "seed" flattish, somewhat shining, smooth, crowned with a short ovate or ovate-triangular tubercle, shorter than the bristles which are usually four in number.

The commonest of the smaller rushes, found in some of its many forms, throughout the entire state. In the drier regions it seldom becomes more than a foot or two high, but in the moist, boggy localities it frequently reaches four feet. Though a common plant it does not furnish much forage as the stems are leafless. In wet meadows it sometimes yields a considerable amount of early feed. The specimens analyzed were collected at Brookings the last of July, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.95	——
Ash	17.33	18.62
Ether Extract	1.99	2.14
Crude Fibre	25.07	26.94
Crude Protein	8.84	9.50
N.-free Extract	39.82	42.79
Total Nitrogen	1.41	1.52
Albuminoid Nitrogen	1.17	1.25

MEADOW RUSH.

(*Scripus atrovirens* Muhl.)

Stem rather stout, one and one-half to three feet high, erect, from perennial roots and root-stocks, triangular, smooth, very leafy; leaves broadly linear, bright green, smooth, softish but becoming more rigid with age; spikelets dull greenish-brown, darkening with age, thickly crowded into close, head-like clusters which are usually arranged in crowded, compound panicles; scales sharp-pointed; achene obovate-oblong, triangular, distinctly pointed, equalling the slender, straightish bristles which are downwardly barbed above and naked below.

Not rare in wet, boggy meadows throughout the state. It is readily eaten by stock but is not common enough to form any considerable portion of the forage except in a few of the moister localities in the state. The specimens analyzed were collected at Brookings the middle of August, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.54	——
Ash	6.78	7.25
Ether Extract	1.45	1.55
Crude Fibre	31.96	34.20
Crude Protein	3.54	3.79
N.-free Extract	49.73	53.21
Total Nitrogen	.57	.61
Albuminoid Nitrogen	.53	.56

RIVER CLUB-RUSH.

(*Scirpus fluviatilis* Gray.)

Stems stout, erect, three to five feet high, from perennial roots, with well developed root-stocks, sharply three angled; leaves large, broad, flat, gradually tapering to a sharp point, smooth except on the midrib and margins which are more or less roughened, upper leaves much exceeding the clusters of spikelets; spikelets in either sessile or stalked clusters of one to five each, ovate or oblong-cylindrical, more or less pointed, rusty brown; scales with edges more or less torn and with somewhat recurving awns; achene or "seed" obovate, pointed, sharply triangular, dull, almost as long as the usually six rigid bristles.

This rush, often called "slough grass" and "three cornered grass," is found generally over the state but is perhaps most plentiful in the eastern part along fresh water streams, lakes and ponds and in sloughs. Its very large, flat leaves, stout triangular stems, rusty brown spikelets and dull, sharply triangular achenes will serve to distinguish it. It is one of the most important of our rushes, furnishing a large amount of early forage which though coarse is readily eaten by all kinds of stock. It is often an important element in lowland hay, particularly that cut from dried up lake beds the first two or three years. The specimens analyzed were cut in wet meadows on the College farm the 1st of July, 1891, and were then just coming into bloom.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.12	——
Ash	9.51	10.24
Fther Extract	1.48	1.59
Crude Fibre	27.00	29.07
Crude Protein	10.13	10.91
N.-free Extract	44.76	48.18
Total Nitrogen	1.62	1.75
Albuminoid Nitrogen	1.44	1.55

SEA CLUB-RUSH.

(*Scripus maritimus* L.)

Stem rather stout, erect, one to three feet high, from perennial roots and root-stocks, sharply three-angled; leaves flat, linear, about as long as the stem, smooth; spikelets one to seven in sessile or more rarely stalked clusters, ovate or oblong-cylindrical, rusty brown; scales with torn edges and soon strongly recurved awns; achene compressed, flat on one side and convex or obtusely angled on the other, minutely pointed, shining, shorter than the one to six bristles. Plate 56.

Not uncommon in most saline soils throughout the state. It may be recognized by its triangular stems, large leaves, rusty brown spikelets and compressed, shining achenes or "seeds." It furnishes a considerable amount of forage chiefly in the form of a coarse hay which is of value mostly because it can be obtained early in the season before the best grasses are fit to cut. It with several other coarse rushes, sedges and grasses are often known indiscriminately as "slough grass."

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.20	——
Ash	9.22	10.04
Ether Extract	2.72	2.96
Crude Fibre	24.10	26.25
Crude Protein	9.04	9.85
N.-free Extract	46.72	50.89
Total Nitrogen	1.47	1.61
Albuminoid Nitrogen	1.14	1.24

HALL'S RUSH.

(*Scirpus hallii* Gray.)

Stems slender, erect, tufted, six inches to one foot high, from annual, fibrous roots; leafless or the upper sheath rarely bearing a small leaf; spikelets one to seven (usually five) in a cluster, ovate-oblong to cylindrical, greenish; involucral leaf much exceeding the cluster of spikelets; scales ovate, conspicuously keeled, with a tooth-like point; stamens two or three; style two-cleft; bristles wanting; achene obovate-orbicular, mucronate, obtusely angled, with very sharp, tranverse wrinkles, brownish.

This rush has been found in but one locality in the state. It grows along the wet boggy shores and in the shallow water of lakes and streams. Though eaten readily by stock it is of but little importance as a forage plant because of its rare occurrence. The specimens analyzed were collected near Bangor, Walworth county, September, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.36	——
Ash	9.87	10.54
Ether Extract	3.27	3.49
Crude Fibre	20.84	22.26
Crude Protein	9.81	10.48
N.-free Extract	49.85	53.24
Total Nitrogen	1.57	1.68
Albuminoid Nitrogen	1.24	1.33

SHARP POINTED RUSH.

(*Scirpus pungens* Vahl.)

Stems rather stout, upright, one to three feet high, from long, stout, running root-stocks, smooth, rigid, sharply three angled; leaves one to three at the base of the stem, four to ten inches long, keeled and channelled; spikelets rusty brown, one to six in sessile clusters, ovoid, over-topped by the long involucral leaf which is a prolongation of the stem; scales ovate, more or less ciliate, with a small awn between the lobes of the two-cleft apex; achene or "seed" obovate, smooth, compressed, longer than the two to six bristles.

Common throughout the entire state along the borders of streams, lakes or ponds. The leaves are so few and the stems so tough and wiry that it is of no value for forage. Stock seldom eat it unless forced to do so. In some parts of the United States this rush is much used in making the seats of "rush-bottom chairs," and often goes by the name of "chair-makers rush." The tough wiry stems render it well adapted to this use. The specimens analyzed were collected near Brookings, July, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.75	——
Ash	12.38	13.42
Ether Extract	1.56	1.69
Crude Fibre	28.42	30.81
Crude Protein	8.78	9.52
N.-free Extract	41.11	44.56
Total Nitrogen	1.41	1.52
Albuminoid Nitrogen	.96	1.04

CHESTNUT-COLORED SEDGE.

(*Cyperus erythrorhizos* Muhl.)

Stems upright, from annual, fibrous roots which are usually reddish in color, obtusely triangular, from six inches to two and one-half feet high, leafy at the base and with four or five leaves clustered about the inflorescence at the top; leaves smooth except the margins which are roughened with very minute spiny teeth, rather large, flat and long pointed; spikelets many, spreading horizontally and arranged in crowded, spike-like clusters at the ends of stalks of varying lengths—the clusters forming an umbel—usually bright chestnut-colored; scales rather closely imbricated in two opposite rows causing the spikelets to be flattish, lanceolate, minutely pointed.

This sedge occurs throughout the Sioux Valley region and possibly elsewhere though as yet not reported. It prefers the low, rich, moist banks of streams and lakes. Not plentiful enough to be of much importance. The specimens analyzed were collected in Brookings county the 1st of August, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	5.95	——
Ash	10.05	10.69
Ether Extract	1.89	2.01
Crude Fibre	28.48	30.28
Crude Protein	9.61	10.22
N.-free Extract	44.02	46.80
Total Nitrogen	1.54	1.63
Albuminoid Nitrogen	1.10	1.17

GIANT SEDGE.

(*Carex aristata* R. Br.)

Stem stout, erect, two to three and one-half feet high, sharply triangular, rough, from perennial roots and stout running rootstocks, leafy; leaves very long, about one-fourth of an inch broad, roughish, at least on the margins; staminate spikes two to four, usually an inch or more long; pistillate spikes two to six, cylindrical, one and one-half to three inches long, more or less stalked and drooping, the upper one often staminate at the top, usually compactly flowered, but sometimes fewer flowered at the base; fruit (perigynium) many ribbed, elliptic-lanceolate, narrowed above into a long beak bearing two long, spreading teeth; scales with a very rough awn-like point, shorter than the perigynium.

Very common, particularly in the Sioux Valley region. It is the most important of all the sedges as it makes a very large part of the growth in the moist, boggy places in the regions where it occurs. It thus furnishes a large part of the early pasturage and hay. In the spring it grows well in the shallow water of the more moist draws and is in good condition to cut when the water dries up in July and August. The specimens analyzed were cut on the College farm on the 10th of July, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.79	——
Ash	8.83	9.58
Ether Extract	2.02	2.19
Crude Fibre	26.85	29.12
Crude Protein	10.57	11.46
N.-free Extract	43.94	47.65
Total Nitrogren	1.69	1.83
Albuminoid Nitrogen	1.54	1.67

LATE-FRUITED SEDGE.

(*Carex retrorsa* Schw.)

Stems stout, erect, tufted, one and one-half to three feet high, from a mass of coarse, fibrous roots, obtusely angled, smooth or slightly roughened above, leafy; leaves broad and soft, roughish —particularly on the margins, much longer than the stems; staminate spikes two, one large, an inch or more long, the other small, about half an inch long, and placed just below the first, their scales pointed, brownish with darker midrib and whitish margins; pistillate spikes three to five, clustered together near the top of the stem and below the staminate spikes, sessile, or the lowest with a short stalk, one to two inches long, very compactly flowered, erect or spreading; fruit (perigynium) yellowish or brownish, very thin and papery, inflated, distinctly nerved, becoming strongly reflexed at maturity, tapering into a long, slender, two-toothed beak; scales very short and small, seldom equalling the body of the perigynium in length.

This sedge is not uncommon in wet, boggy places along streams and lakes in the Sioux Valley. It has not yet been reported elsewhere in the state. It is very tender and juicy and is readily eaten by stock. It seldom appears in hay as it only grows in places usually too wet to be mowed. It is often an important factor in the forage furnished by many of our lowland pastures. The specimens analyzed were collected along the Sioux River near Brookings.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.11	——
Ash	20.61	21.95
Ether Extract	2.84	3.02
Crude Fibre	19.81	21.10
Crude Protein	14.74	15.70
N.-free Extract	35.89	38.23
Total Nitrogen	2.36	2.51
Albuminoid Nitrogen	1.51	1.60

SILVERY TOPPED SEDGE.

(*Carex siccata* Dewey.)

Stems erect, clustered, sharply three-angled, one to two feet high (usually taller than the leaves); spreading extensively by means of creeping root-stocks; perennial; leaves erect, narrow, taper-pointed, smooth, or roughish on the margins; spikes silvery brown, longer than the scale-like bracts, three to ten, loosely arranged in an oblong head which is seldom over an inch in length; the middle spikes (or sometimes the entire head) staminate.

This sedge is quite common in the eastern part of the state where it grows on rather dry bottoms and in swales. It may be known by its silvery brown heads and by its habit of forming extensive mats. In some instances it yields a considerable amount of forage. The specimens analyzed were collected in Brookings county, the last of June, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.03	——
Ash	9.47	10.30
Ether Extract	2.21	2.40
Crude Fibre	24.64	26.79
Crude Protein	13.66	14.85
N.-free Extract	41.99	45.66
Total Nitrogen	2.19	2.38
Albuminoid Nitrogen	1.53	1.66

STRAW-COLORED SEDGE.

(*Carex straminea* Willd.)

Stems erect, rather slender, clustered, one to three feet high, three angled, smoothish or rough above on the angles, sometimes nodding in fruit, from perennial, fibrous roots; leaves narrow, long-pointed, stiff, usually shorter than the stems but equalling them in some of the forms; spikes three to eight, usually distinct, globular or ovoid, tawny or straw-colored, clustered at the end of the stem; "seed" (perigynium) from narrowly to broadly ovate, wing-margined, nerved on both faces; about as long as the acute scales. Plate 57 is from a photograph of var. *brevior* Dewey.

This is one of the commonest sedges and is found in some of its many forms in all parts of the state. It thrives on a variety of soils, being found in dry places, swales or bogs. It furnishes a considerable amount of forage in many localities. The specimens analyzed were collected at Brookings on the 7th of July, 1892, and belong to the variety *aperta* of Boott.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.79	———
Ash	8.04	8.72
Ether Extract	2.14	2.32
Crude Fibre	31.50	34.16
Crude Protein	7.60	8.24
N.-free Extract	42.93	46.56
Total Nitrogen	1.22	1.32
Albuminoid Nitrogen	1.00	1.09

NARROW-FRUITED SEDGE.

(*Carex sychnocephala* Carey.)

Stems erect, slender, in large tufts, six to sixteen inches high, smooth, leafy, from a mass of tough, fibrous, perennial roots; leaves narrow, long-pointed, longer than the stems, rough on the margins; spikes green, oblong, densely crowded into an oblong head which is about three-fourths of an inch long and from which proceed several long leaf-like bracts; "seed" (perigynium) slender, faintly nerved, scarcely margined, usually somewhat longer than the sharp-pointed scale.

This sedge is found in boggy places along streams and lakes and is not uncommon in the Sioux Valley. It is quite palatable and produces an abundance of leaves but is too rare to be of much importance except in a few localities. It may be easily distinguished from all other sedges by its peculiar leafy heads. The specimens analyzed were collected near Brookings the last of June, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.78	——
Ash	11.25	12.20
Ether Extract	3.70	4.01
Crude Fibre	24.41	26.47
Crude Protein	8.48	9.20
N.-free Extract	44.38	48.12
Total Nitrogen	1.36	1.47
Albuminoid Nitrogen	1.27	1.38

UPRIGHT SEDGE.

(*Carex stricta* Lam.)

Stems erect, slender, tufted, or often in large clumps, sharply three-angled, rough above on the angles, one and one-half to three feet or more high; perennial; leaves long and narrow, pointed, roughened on the margins; spikes three to five, scattered, erect or rarely spreading, all sessile except the lowest one which is more or less stalked, dense flowered, varying from one-half to two inches in length, the upper one or two (rarely three) staminate, the remainder pistillate (or sometimes the upper ones staminate at the top); fruit (perigynium) small, flattened, ovate, rather faintly few-nerved, with a very short, mostly entire beak; scales narrow, usually bordered with purplish, acutish, about as long as the fruit.

This is one of the commonest sedges in the state and is found throughout in low wet meadows and along swales and margins of ponds, lakes and streams. It enters largely into most of the lowland forage. The specimens analyzed were collected at Brookings the 1st of June, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.10	——
Ash	10.23	11.13
Ether Extract	2.32	2.52
Crude Fibre	27.69	30.13
Crude Protein	10.33	11.24
N.-free Extract	41.33	44.97
Total Nitrogen	1.65	1.80
Albuminoid Nitrogen	1.21	1.31

FOX SEDGE.

(*Carex vulpinoidea* Michx.)

Stem mostly upright, stiff, sharply three angled, rough, especially above, one to two and one-half feet high; perennial; leaves usually longer than the stem, flattish, long-pointed, roughish on the margins; spikes numerous, densely flowered, arranged in an interrupted, more or less compound head which is from one to three or even four inches long, dull greenish brown, at least the lower spikes provided with slender, setaceous bracts; fruit (perigynium) small, rather narrowly ovate, nerved on both faces; scales with very sharp, rough points.

Fox sedge is exceedingly abundant throughout the entire west. It prefers low prairies and rather dry swales It usually grows in rather large bunches and may be recognized by its large heads which have a more or less bushy appearance owing to the numerous bracts. It is readily eaten by stock and adds materially to the native forage. The specimens analyzed were collected at Brookings early in August, 1893.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	5.89	——
Ash	8.87	9.43
Ether Extract	2.05	2.18
Crude Fibre	29.11	30.93
Crude Protein	9.61	10.21
N.-free Extract	44.47	47.25
Total Nitrogen	1.54	1.63
Albuminoid Nitrogen	1.12	1.19

BUR-REED.

(*Sparganium eurycarpum* Engelm.)

Stems stout, erect, smooth, two to four feet high, from perennial, creeping root-stocks and fibrous roots, leafy; leaves thickish, equalling or exceeding the stem, linear, flat and keeled; flowers in separate, dense heads; the upper staminate, the lower pistillate; staminate flowers consisting only of stamens and minute irregularly placed scales; the pistillate ones consisting each of a sessile pistil surrounded by three to six scales; fruit, broad, sessile, often two-seeded, many angled, about one-third of an inch long; fruit heads a half a dozen or less on each plant, about an inch in diameter.

This plant is not uncommon in shallow water or in recently dried up ponds and sloughs. It often makes up a large part of the vegetation in lake beds and boggy pastures. It is not eaten a great deal by stock as long as other and better forage plants are plentiful but when pasturage is low it is often rescrted to. The specimens analyzed were collected at Brookings in the College pastures on the 10th of July, 1891.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.78	——
Ash	6.73	7.22
Ether Extract	1.23	1.32
Crude Fibre	25.94	27.83
Crude Protein	6.15	6.60
N.-free Extract	53.17	57.04
Total Nitrogen	.98	1.06
Albuminoid Nitrogen	.88	.95

BIG HEADED BOG-RUSH.

(*Juncus nodosus* L.)

Stems erect, slender or somewhat robust, smooth, rather rigid, leafy, one to two feet high, from very slender, creeping tuber-bearing root-stocks; leaves slender, long-pointed; flowers arranged in one or more dense, many flowered, brown heads; calyx of six glume-like, awl-pointed sepals; stamens six, with the oblong anthers shorter than the filaments; capsule slender, triangular, pointed, longer than the sepals. The commoner form (var. *megacephalus* Torr.) has stout stems, often three feet high, thicker leaves and larger (thirty to eighty flowered) heads.

This bog rush is more or less common throughout the state, occurring in low, boggy places and along wet, gravelly banks. When young it is often eaten by stock of all kinds. It is of little importance as a forage plant except perhaps in pastures consisting largely of old lake beds or bogs. The specimens analyzed were collected at Brookings about the middle of July, 1893, and belong to the variety *megacephalus*.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.32	———
Ash	7.66	8.18
Ether Extract	1.78	1.90
Crude Fibre	36.57	39.04
Crude Protein	6.88	7.34
N.-free Extract	40.79	43.54
Total Nitrogen	1.10	1.18
Albuminoid Nitrogen	.92	.98

SLENDER BOG-RUSH.

(*Juncus tenuis* Willd.)

Stems erect, simple, tufted, wiry, leafy below; roots perennial; leaves flattish or rolled, pointed, about six inches long; flowers solitary, in loose panicles which are shorter than the involucral leaves; sepals greenish, very sharp-pointed, spreading in fruit; stamens six, with anthers nearly equal to the filaments; capsule greenish, ovoid, shorter than the sepals; seeds small, not conspicuously pointed.

This is a common plant found throughout the state, often on high prairies as well as on low ground. Though rather tough and wiry it is readily eaten by stock. The amount of forage yielded is so small, however, that the plant is of little value. The specimens analyzed were collected at Brookings, July, 1893.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.10	——
Ash	5.32	5.79
Ether Extract	1.67	1.82
Crude Fibre	34.07	37.07
Crude Protein	6.37	6.93
N.-free Extract	44.47	48.39
Total Nitrogen	1.02	1.11
Albuminoid Nitrogen	.73	.80

BECKWITH'S CLOVER.

(*Trifolium beckwithii* Brewer.)

Stems ascending, four to nine inches high, from strong, perennial, creeping root-stocks; leaves trifoliate; leaflets oblong to oblanceolate, conspicuously veined, obtuse or the upper ones acute, irregularly toothed, usually one to one and one-half inches long; stipules ovate to lanceolate, acute, entire; flowers about half an inch long, reddish, purple, in terminal heads which are an inch or more in diameter; calyx teeth linear-subulate, straight, equalling the tube in length; pod smooth, several seeded. Plate 58. (See plates at the end of Bulletin.)

This is the only species of the true clovers known to be a native of the state. It is common in low meadows along the upper Sioux Valley but has not been reported from the other regions. It is very persistent and endures excessive grazing very well. It is most too small to afford anything but pasturage. The flower-heads are very similar to those of common red clover but the plants are much smaller and the leaflets are much narrower. Efforts are being made to grow this clover on the Station grounds and there is a possibility that it may prove of value as a cultivated forage plant. The specimens analyzed were cut on the College pastures the middle of June, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.64	———
Ash	7.59	8.31
Ether Extract	2.71	2.97
Crude Fibre	25.11	27.48
Crude Protein	12.59	13.78
N.-free Extract	43.36	47.46
Total Nitrogen	2.01	2.20
Albuminoid*	1.51	1.65

RED CLOVER.

(*Trifolium pratense* L.)

Stems ascending, more or less hairy, one to two feet high, from rather short-lived perennial roots; leaves trifoliate, with usually rather long leaf-stalks; leaflets from half an inch to an inch and a half long, oval or obovate, often notched at the apex, sessile, usually with a large pale spot on the upper side; flowers in large ovoid, sessile heads; pod small, one-seeded, included in the calyx; seed kidney-shaped, from greenish-yellow to pale reddish brown.

Red clover is a native of the Old World and is now extensively cultivated on both hemispheres. It is the best of the clovers, being an excellent hay grass as well as affording, under proper conditions, a large amount of pasturage. It makes an excellent pasturage for hogs. There is great difference of opinion as to its value in the Dakotas. On the Station grounds it has done fairly well one year with another. It seems to endure the drouth of summer better than the dry freezing of the winter. It does best when sown with timothy. In the Sioux Valley region there are a great many fields of these forage plants that are yielding excellent returns. Red clover has given the best results when sown in early spring on well prepared soil. Orchard grass may be sown with it instead of timothy. Clover is an excellent soiling plant and may be used to advantage on fields that have been worn out by wheat raising. The specimens analyzed were cut from the experimental plats on the Station grounds, July 16th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.15	——
Ash	7.02	7.64
Ether Extract	2.15	2.34
Crude Fibre	34.11	37.14
Crude Protein	10.79	11.75
N.-free Extract	37.78	41.13
Total Nitrogen	1.73	1.88
Albuminoid Nitrogen	1.32	1.44

CRIMSON CLOVER.

(*Trifolium incarnatum* L.)

Stems erect, tufted, soft, hairy, one to two feet high; annual; leaves trifoliate, soft hairy; stipules broad, with short, leafy tips, more or less toothed; leaflets broadly obovate or almost round; flowers about half an inch long, in oblong or cylindrical heads which are usually one or two inches long; calyx with narrow, subequal teeth, with copious long white hairs; corolla with bright scarlet or crimson, or rarely pinkish petals. Plate 50.

Crimson clover is a native of the southern part of Europe from whence it has been introduced into various parts of the United States. It is an annual and hence is of no value in permanent pastures. In Delaware and Virginia it has been grown with profit and is highly prized as a soiling plant. It is too tender for our climate. Plats of this clover grown on Station grounds were not a success. It suffered severely from late frost and dry weather and yielded very poorly. Similar results have been obtained in Michigan, Nebraska and other states of the North and West. The specimens analyzed were cut from the experimental plats on the Station grounds on the 13th of July, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.03	——
Ash	11.86	12.90
Ether Extract	2.15	2.34
Crude Fibre	29.96	32.58
Crude Protein	12.59	13.69
N.-free Extract	35.41	38.50
Total Nitrogen	2.01	2.19
Albuminoid Nitrogen	1.34	1.46

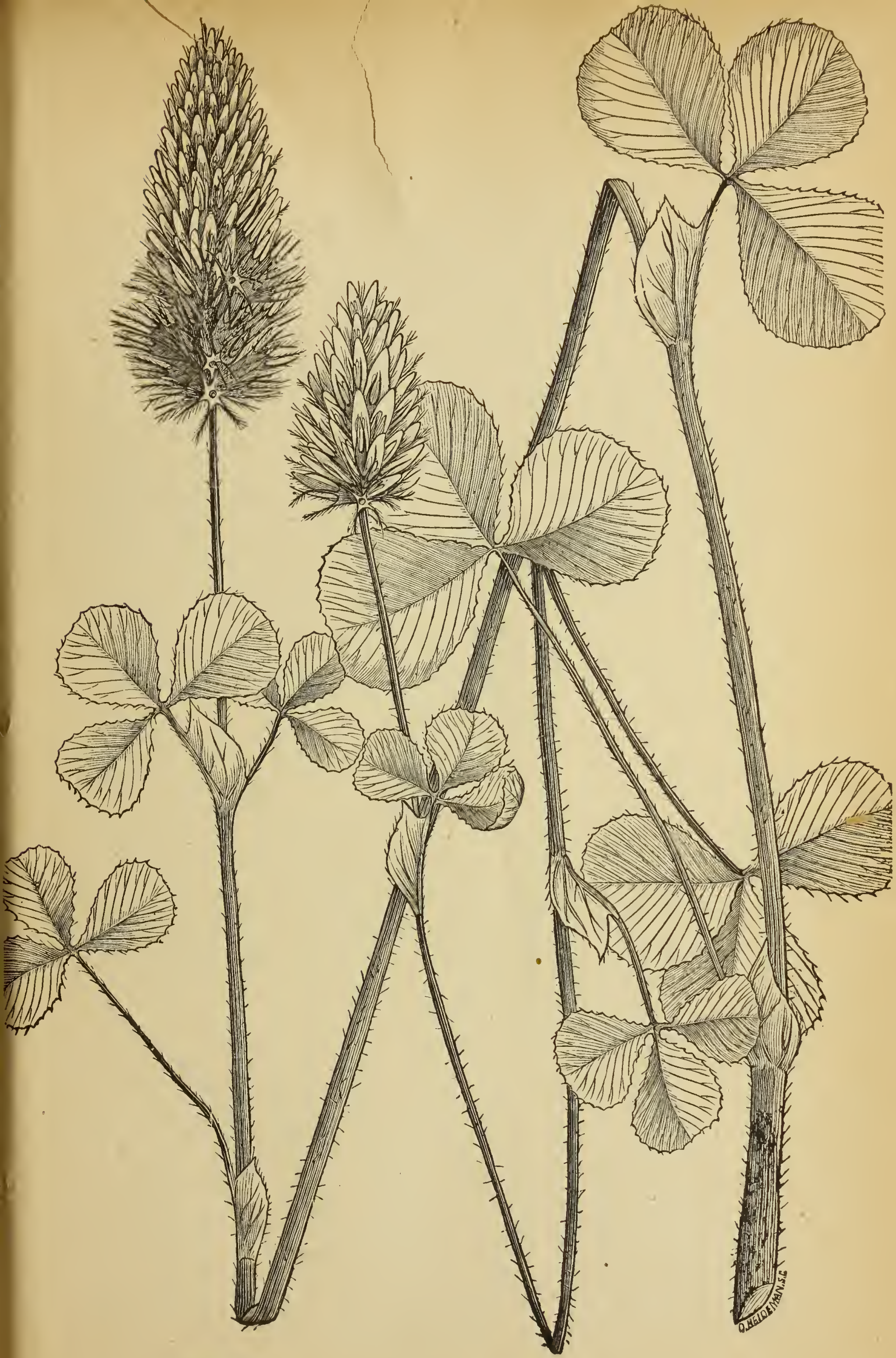

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PLATE 50—Crimson Clover,

ALSIKE.

(*Trifolium hybridum* L.)

Stems smooth, ascending, branched, one to two feet high, from perennial roots; stipules with long, sharp points and green veins; leaf-stalks long; leaflets ovate or oblong, toothed; heads globular, about three-fourths of an inch in diameter, on long stalks; flowers pinkish, on short pedicels, recurved after blooming; calyx whitish, smooth, with a few scattered hairs between the subequal, greenish teeth; pod about four-seeded. Plate 51.

Alsike is a native of the Old World. It was first cultivated in Sweden and derived its common name from a village of that country. It is often called hybrid clover because of the fact that it was originally supposed to be a hybrid between red clover and white clover. It is much prized by bee-keepers as the flowers contain an abundant supply of nectar which is easily reached by honey bees. It is an excellent plant for permanent pastures or meadows, yielding an abundance of seed and being much more persistent than red clover. As a rule it does not reach full development the first year but keeps improving with age. Tall fescue, timothy, smooth brome and other strong growing grasses are usually sown with this clover in meadows as its stems are rather weak and it does not stand up well when alone. On the Station grounds it has done better than any other clover being hardy and yielding well. Plats of it and timothy are doing well in every way. It promises to be of great value in this state particularly where irrigation is possible. The specimens analyzed were cut from the experimental plats, July 13th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.29	——
Ash	7.92	8.54
Ether Extract	1.87	2.02
Crude Fibre	29.17	31.46
Crude Protein	12.64	13.63
N.-free Extract	41.11	44.34
Total Nitrogren	2.02	2.18
Albuminoid Nitrogen	1.32	1.42

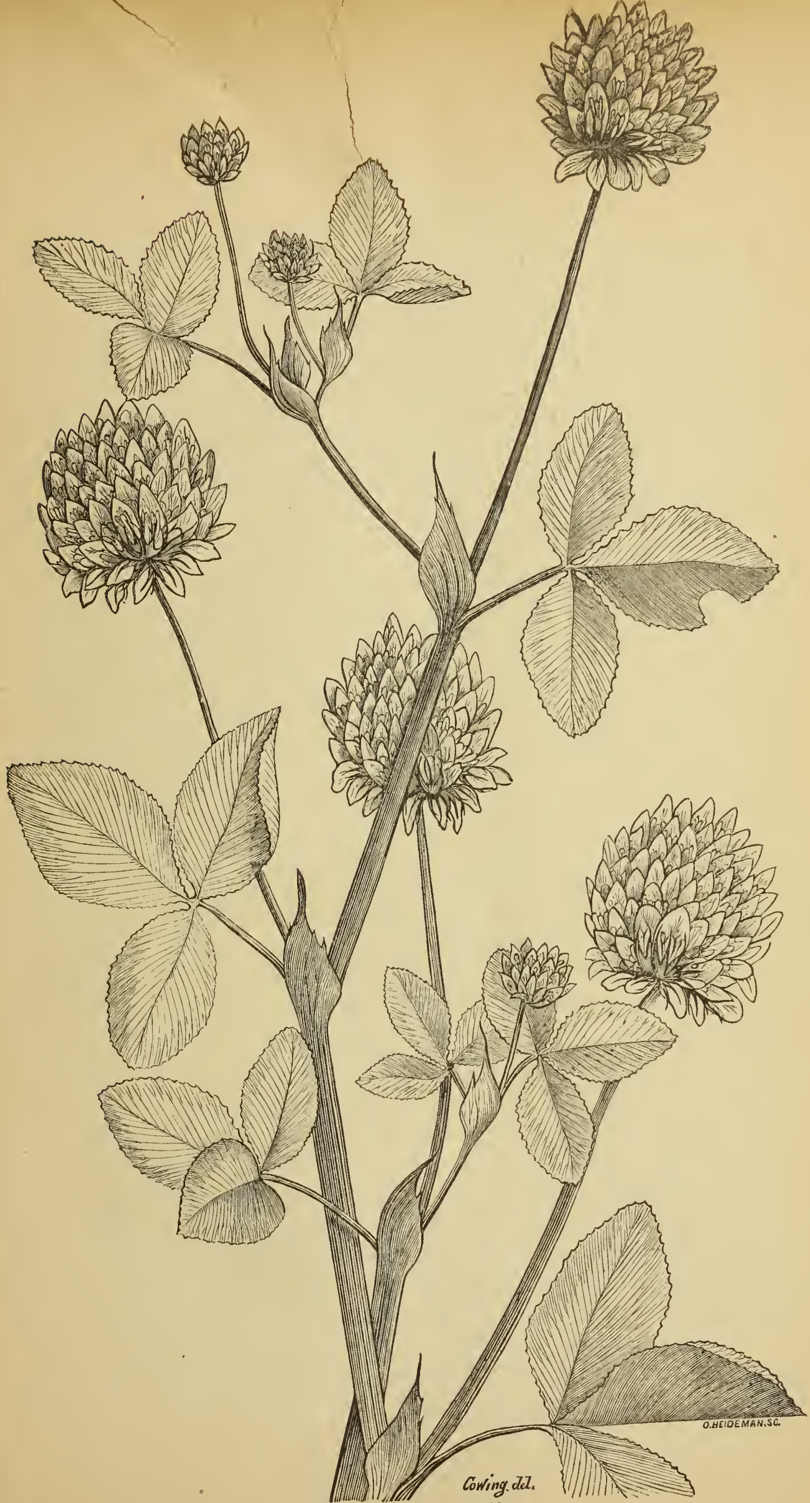
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PLATE 51—Alsike.

WHITE CLOVER.

(*Trifolium repens* L.)

Stems low, creeping, often rooting at the joints; smooth; perennial; leaves trifoliate, usually with rather long (two to four inch) leaf-stalks; stipules narrow and scale-like, long-pointed; leaflets obovate with notched apex or inversely heart-shaped, rather obscurely toothed on the margin; heads loosely flowered, an inch or less in diameter, on very long (three to eight inch) stalks; flowers white or tinged with rose, becoming reflexed with age; calyx smooth, pale, with greenish teeth; pod four to six seeded.

This clover has been introduced over the greater part of the state and is particularly common along the grades of the older railroads. It thrives on a great variety of soils and does better than red clover on very poor land. It is too low growing to be of much value as a hay producing plant, but it is excellent for pastures and lawns. It is very persistent enduring excessive grazing and tramping well. On the College grounds it has proven perfectly hardy and has done well even on the poorest of soils. It comes readily from the seed and soon makes a good sod which persists through seasons of extreme drouth or of severe freezing. For lawns or permanent pastures it should be sown in mixtures with the blue grasses, fescues, or other lawn or pasture grasses. Like all the rest of the clovers it should be sown in early spring. The specimens analyzed were cut from the experimental plats on the Station grounds the middle of August, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.50	——
Ash	10.89	11.77
Ether Extract	2.03	2.19
Crude Fibre	21.33	23.06
Crude Protein	13.20	14.27
N.-free Extract	45.05	48.70
Total Nitrogen	2.11	2.28
Albuminoid Nitrogen	1.54	1.66

FENUGREEK.

(*Trigonella foenum-graecum.*)

Stems erect, more or less branched, smoothish or somewhat hairy, a foot or more high; root annual; leaves trifoliolate; leaflets smoothish, wedge-oblong, obtuse, coarsely toothed above, one-half to one inch or more long; flowers one or two in the axils of the leaves, sessile or nearly so, yellowish; pod linear, more or less curved, veiny, long pointed.

A forage and medicinal plant introduced from Europe. It is an annual and is scarcely worth cultivating here as a forage. The yield is not very heavy and the forage is not relished by stock. The plant has a very strong scent which remains for a long time. The specimens analyzed were cut from the experimental plats July 9th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.45	——
Ash	10.66	11.64
Ether Extract	1.97	2.15
Crude Fibre	24.01	26.23
Crude Protein	18.24	19.92
N.-free Extract	36.67	40.05
Total Nitrogen	2.92	3.19
Albuminoid	1.66	1.81

YELLOW MELILOT, YELLOW SWEET CLOVER.

(*Melilotus officinalis* (L.) Lam.)

Stems upright, branched, smooth, two to six feet high; root biennial; leaves pinnately trifoliolate; stipules small, very narrow, sharp-pointed; leaflets obovate-oblong, smooth, obtuse, sharply toothed on the margins; flowers yellow, in spike-like racemes, becoming reflexed in fruit; pod small, ovoid, wrinkled, rather longer than the calyx, one to two seeded.

This is a very hardy plant, a native of the Old World, which occurs either under cultivation, or as an escape, throughout the greater part of the United States. The forage afforded is rather coarse and when fed alone is not relished by stock, owing, it is thought, to a bitter principle which is present in the plant. Mixed with other plants it may be used when better forage is scarce. It may, perhaps, be of value when used as silage since it is very hardy and yields heavily. It is an excellent bee-plant. In many parts of the East it is regarded as a weed but is also said to be valuable as a green manure. It is occasionally used in medicine. The specimens analyzed were cut from the experimental plats on the Station grounds, July 12th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.68	——
Ash	6.00	6.57
Ether Extract	1.57	1.72
Crude Fibre	38.78	42.47
Crude Protein	13.41	14.68
N.-free Extract	31.56	34.56
Total Nitrogen	2.15	2.35
Albuminoid Nitrogen	1.34	1.47

WHITE MELILOT, SWEET CLOVER.

(*Melilotus alba* L.)

Similar to yellow melilot but with the leaflets as if cut off square at the tips, the flowers white, and the standard of the corolla longer than the other petals.

This has about the same distribution as yellow melilot but is more common in South Dakota and is much more valuable as a forage plant. Though stock do not like it very well while green they eat it readily when cured with other forage plants. Both of the sweet clovers are fragrant while drying. White melilot is a valuable bee plant, producing an abundance of nectar. As it is only a biennial at most and grows so rank it may often be used as a nurse plant to shade the ground and protect certain of the slower growing forage plants. Like yellow melilot it is very hardy and may prove of value in silage mixtures. White melilot is often advertised in seed catalogues as "Bokara Clover." The specimens analyzed were cut from the experimental plats on the Station grounds, July 12th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.59	——
Ash	5.18	5.55
Ether Extract	1.52	1.63
Crude Fibre	42.55	45.55
Crude Protein	8.48	9.08
N.-free Extract	35.68	38.20
Total Nitrogen	1.36	1.45
Albuminoid Nitrogen	.97	1.04

GOAT'S RUE.

(*Galega officinalis.*)

Stems erect, branching, smooth, one and one-half to two feet high, leafy; root perennial; leaves pinnate, with usually seven to thirteen leaflets which are smooth, oblong-elliptical to lanceolate, entire, the apex rounded abruptly into a slender spine-like point; stipules arrow shaped, sharp-pointed; flowers violet-purple, in loose, spike-like racemes which are borne on stalks equalling or exceeding the leaves; pods about an inch long, several-seeded. Plate 52.

This is a recent introduction and gives promise of value as a forage for this state. In Kansas it is said to be an excellent forage plant, resisting drouth well. On the Station grounds it makes a good growth, yields well and seems to be hardy. Some difficulty was experienced in getting a stand. It deserves a more extended trial. The specimens analyzed were cut from the experimental plats August 9th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	9.63	——
Ash	6.39	7.07
Ether Extract	2.57	2.84
Crude Fibre	30.38	33.62
Crude Protein	15.42	17.06
N.-free Extract	35.61	39.40
Total Nitrogen	2.47	2.73
Albuminoid Nitrogen	1.93	2.14

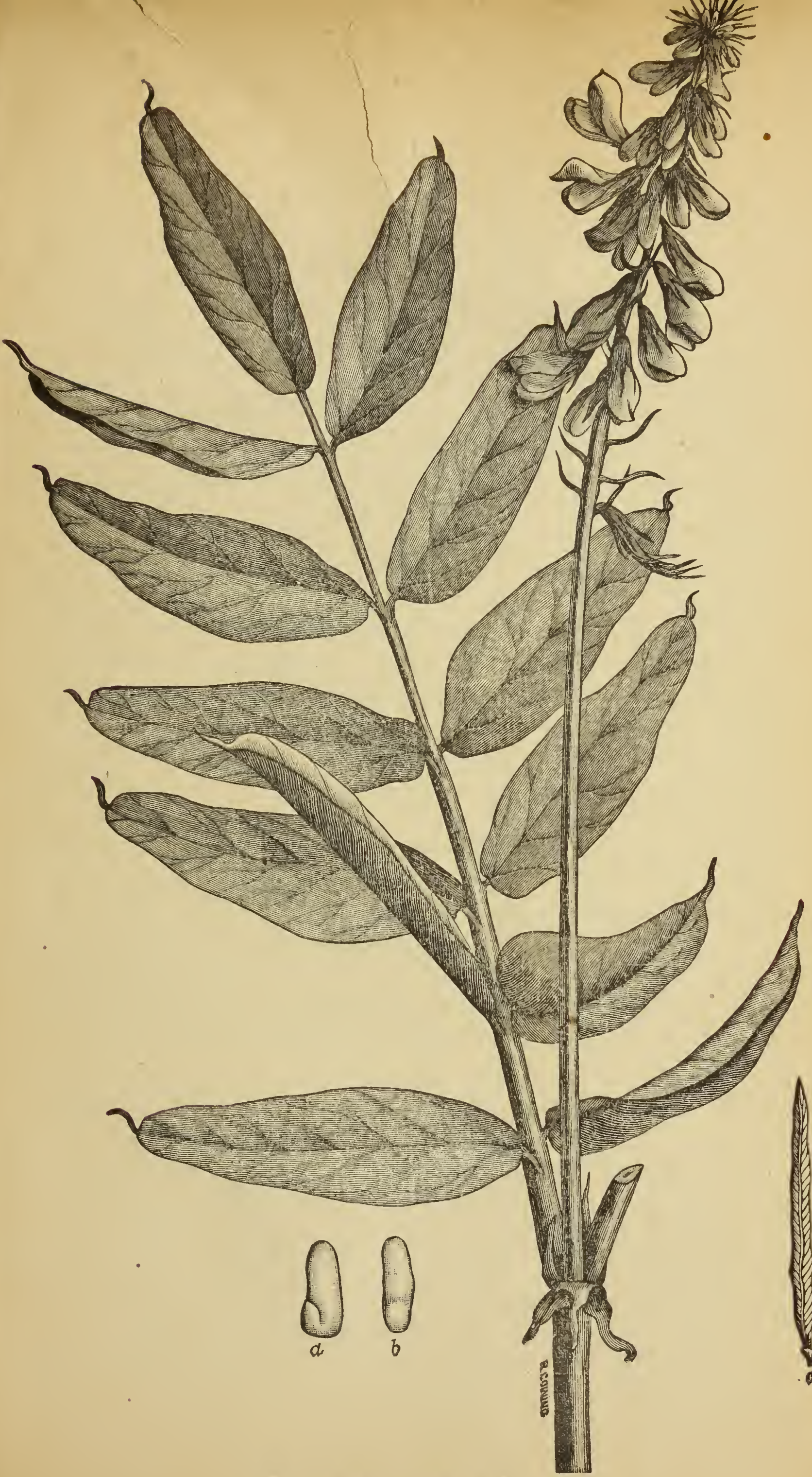

PLATE 52—Goat's Rue.

WILD VETCH.

(*Hosackia purshiana* Benth.)

Stems erect, branching, from smooth to silky-hairy, six to eighteen inches high, from an annual root; leaves nearly sessile, usually three-foliolate; leaflets rather narrowly ovate to lanceolate, one-fourth to nearly an inch long, the two lateral leaflets very short-stalked or sessile, the terminal one distinctly stalked; flowers small, solitary in the axils of the upper leaves, reddish; flowerstalks half an inch or more long, bearing a single small leaflet at the base of the flower; pod linear, compressed, about six seeded; seeds flattish, ellipsoid, smooth and shining, about one-sixteenth of an inch long. Plate 53.

This plant belongs to the same family as the cultivated vetches and clovers as may be seen by the flowers and seedpods. It is very common throughout the entire state but is most plentiful in the Missouri Valley. The period of blooming is a long one and towards the end of the season flowers, young pods and mature or bursting pods may be found on the same plant. It is readily eaten by all kinds of stock and is regarded by stockmen as very important native forage. Even when grazed closely it will usually mature seeds enough to insure a sufficient stand the next season. It seems to be worthy of cultivation and should receive an extended trial in the drier parts of the state. The specimens analyzed were collected at Sand Lake, Brown county, July 23rd, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.73	—
Ash	8.35	9.05
Fther Extract	2.73	2.96
Crude Fibre	21.48	23.28
Crude Protein	17.57	19.04
N.-free Extract	42.14	45.67
Total Nitrogen	2.81	3.05
Albuminoid Nitrogen	2.28	2.47

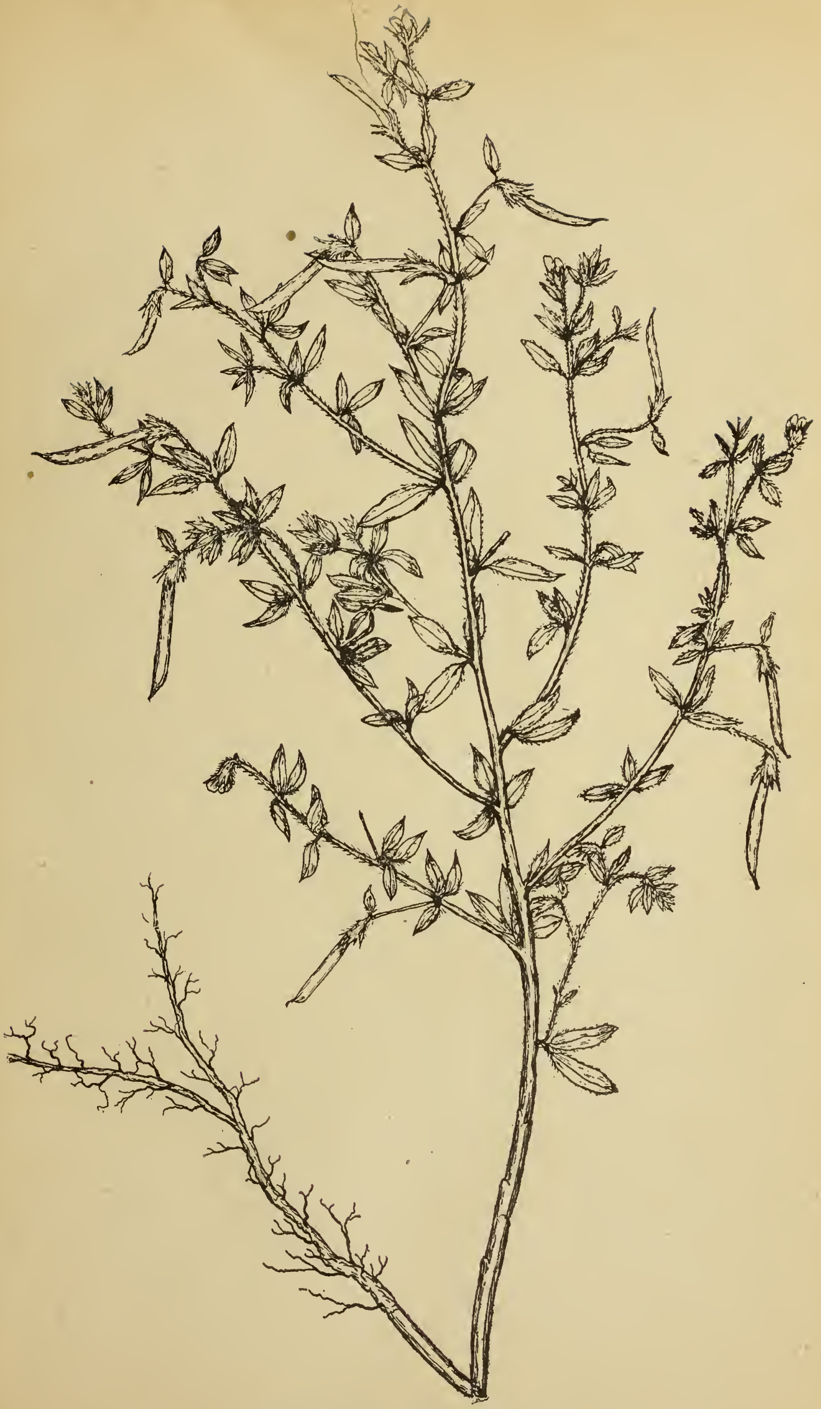

PLATE 53—Wild Vetch.

ALFALFA, LUCERNE.

(*Medicago sativa* L.)

Stems erect, branched, smoothish, one to two and one-half feet high; root perennial, deep growing; leaves pinnately trifoliolate; leaflets obovate-oblong, toothed, notched at the tip, the lateral ones nearly sessile, the terminal one stalked; stipules rather narrow, pointed, adhering to the base of the leafstalk; flowers blue or purple, in short, dense racemes which are on stalks exceeding the leaves; pod spirally twisted in about two turns, finely reticulated, several seeded. Plate 54.

Alfalfa is an introduced plant from the Old World and is very widely cultivated throughout the United Statss. It is a very deep rooting plant and thrives best in a rich sandy loam with a deep porous subsoil. On the dry soil of the College campus the roots have been traced down ten feet or more. It is not a vigorous grower while young and hence a good sod is not always easy to get. After once well established, however, it endures drouth well and does not winter-kill easily. The yield of forage is good and of excellent quality if properly cut and cured. It should be cut as soon as it begins to flower. Alfalfa should be sown in the spring as soon as warm weather is assured, on clean, well prepared soil. On the Station grounds it has done best when put in with a drill. About eighteen or twenty pounds of seed should be sown to the acre. In regions where irrigation is practiced this is a favorite forage plant, giving four or five or even more cuttings in a year. It should be given an extended trial in South Dakota particularly in the artesian basin. The specimens analyzed were cut on the College farm, July 9th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.71	—
Ash	6.55	7.10
Ether Extract	1.30	1.41
Crude Fibre	42.61	46.17
Crude Protein	8.68	9.41
N.-free Extract	33.15	35.92
Total Nitrogen	1.39	1.51
Albuminoid Nitrogen	1.08	1.17

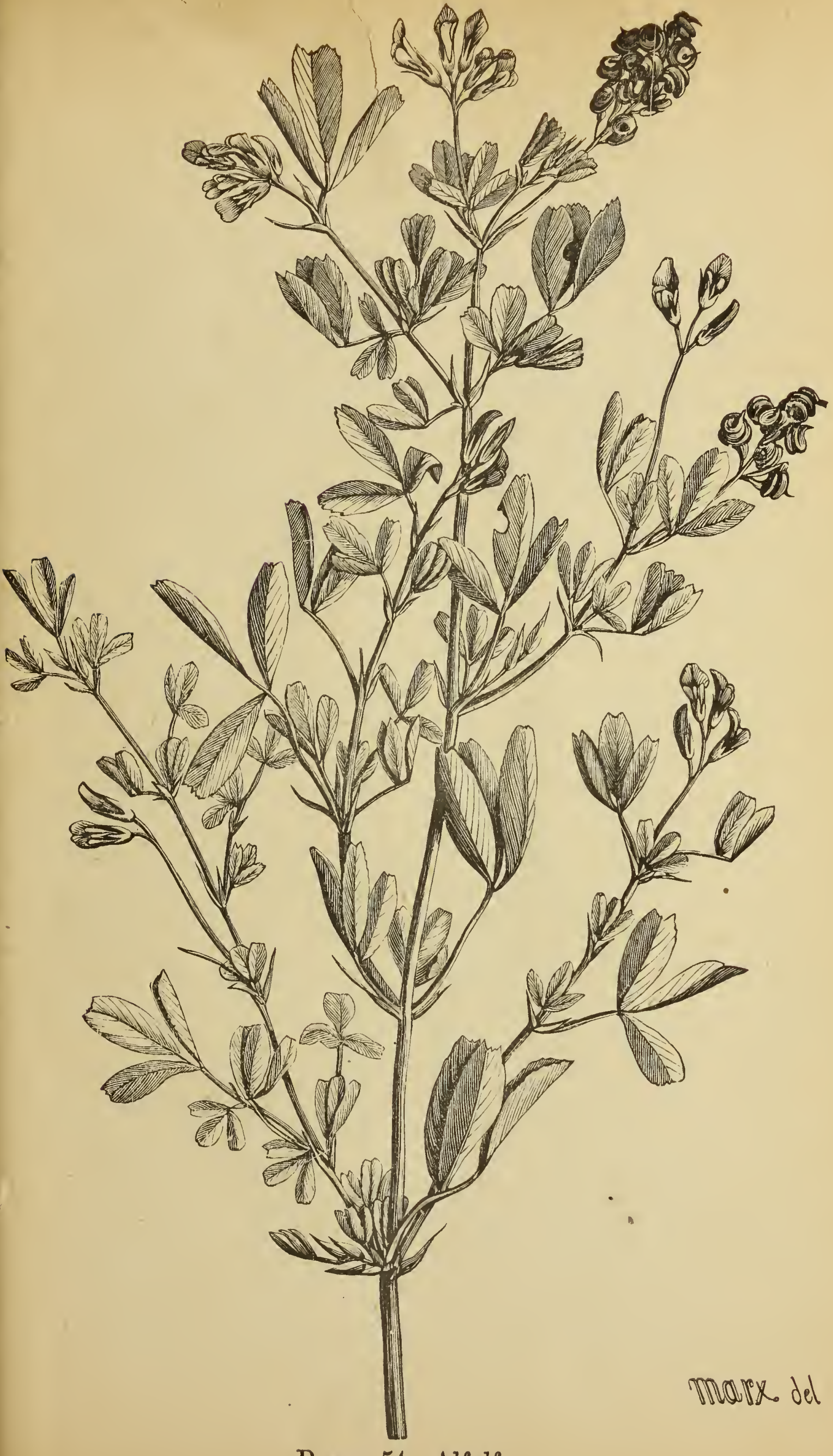

PLATE 54—Alfalfa.

SAINFOIN, ESPARSETTE.

(*Onobrychis sativa.*)

Stems upright, more or less straggling, branched, smooth, one to two feet high; root perennial; leaves pinnate; leaflets small, numerous, oblong, somewhat hairy on the under surface, entire; flowers pink, in rather loose, long-stalked spikes; pods short, flat, reticulately roughened and prickly, toothed on the back, one seeded. Plate 55.

This plant belongs to the clover family and is a native of Europe and Asia. In some parts of the Old World it is very highly prized as a forage, especially in regions where chalky or gravelly soils prevail. In Iowa and Kansas Sainfoin has given some promise of value but the experiments at our own Station give rather negative results thus far. It will be given further trial. The specimens analyzed were cut from the experimental plats on the Station grounds July 25th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	10.09	——
Ash	6.58	7.32
Ether Extract	1.74	1.94
Crude Fibre	33.38	37.13
Crude Protein	10.68	11.88
N.-free Extract	37.53	41.74
Total Nitrogen	1.71	1.90
Albuminoid Nitrogen	1.22	1.35

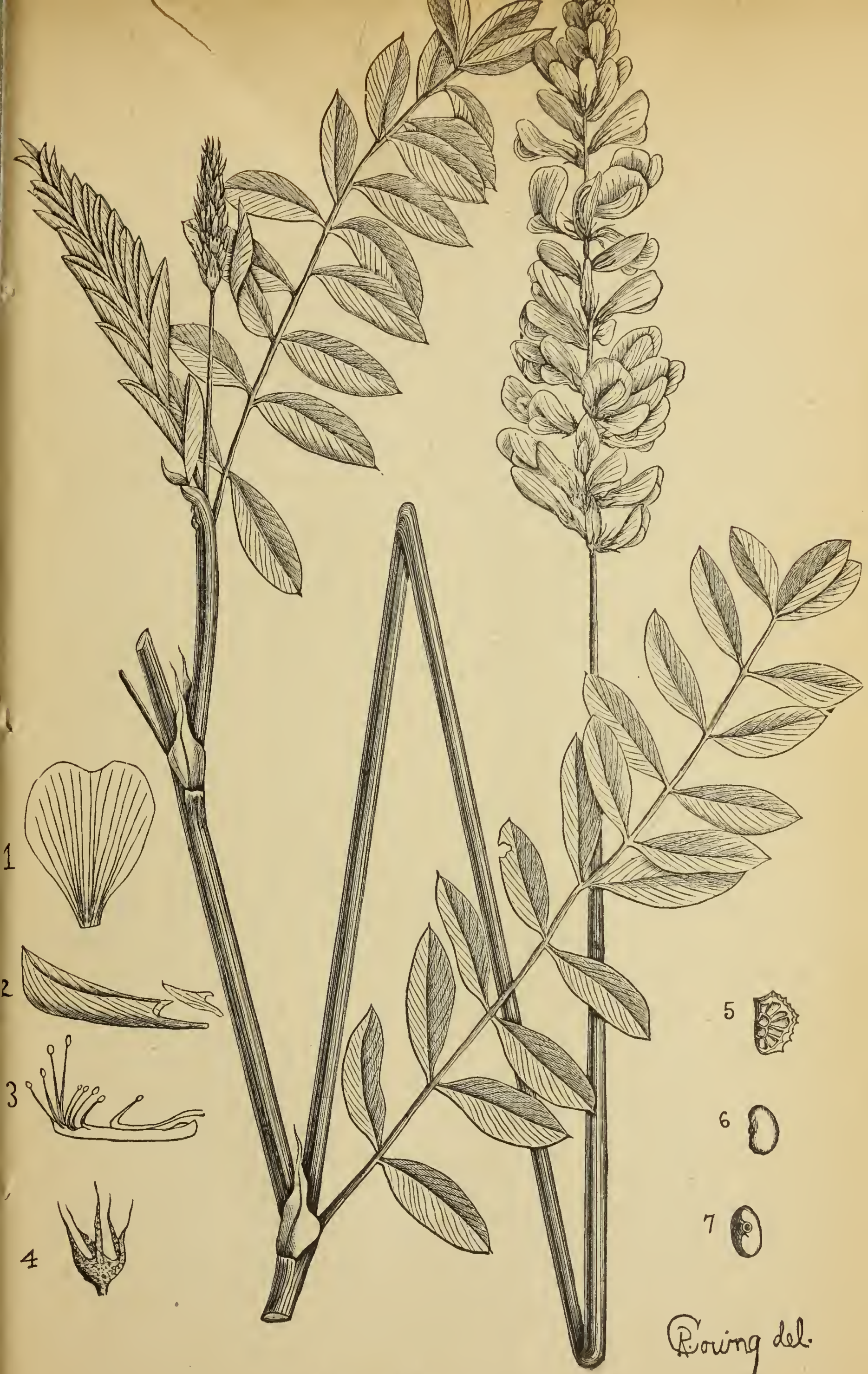

PLATE 55—Sainfoin.

BURNET CLOVER.

(*Poterium sanguisorba* L.)

Stems upright, tufted, smoothish, angular, one to two feet high; root perennial; leaves pinnately compound, with seven to eleven ovate or roundish, deeply and coarsely serrate leaflets; flowers in heads, greenish or purplish, those in the lower part of the head staminate, with numerous, drooping stamens, those in the upper part of the head pistillate; "seeds" (achenes) dry, included in the calyx.

Burnet clover does not belong to the true clovers but is a member of the *Rose* family. The forage is of good quality but thus far we have been unable to get a satisfactory stand. After once started it seems perfectly hardy, neither winter-killing or suffering much from drought. The specimens analyzed were cut from the experimental plats on the Station grounds, August 5th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.94	——
Ash	9.26	10.15
Ether Extract	4.55	4.99
Crude Fibre	18.07	19.80
Crude Protein	14.23	15.59
N.-free Extract	45.15	49.47
Total Nitrogen	2.28	2.50
Albuminoid Nitrogen	2.07	2.27

GIANT SPURREY.

(*Spergula maxima.*)

Stems weak and reclining, smoothish or glandular, hairy above, usually a foot or more high; annual; leaves numerous, whorled, linear and thread-like; flowers white, very numerous, arranged in a panicled cyme; petals rather shorter than the sepals; pod exceeding the calyx, smooth and shining, at maturity splitting into five valves which are opposite the sepals; seeds orbicular, blackish, rough, with a narrow, pale margin; flower stalks becoming more or less reflexed in fruit.

Giant spurrey is a native of the Old World which has become widely introduced throughout the United States. In Europe it is often used as a forage plant. Cattle and sheep are said to be very fond of it. On the Station grounds it makes a fair growth and is perfectly hardy but the yield is light and the crop is not an easy one to save owing to the habit of growth of the plant. The crop may be harvested in from eight to twelve weeks after sowing hence spurrey is a very good thing to use for a catch crop. On the whole it is not as profitable as millet and many other forage plants but it will be useful during short seasons or in case of failure of crops requiring a longer season to come to maturity. The specimens analyzed were cut from the experimental plats on the Station grounds, July 9th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	7.39	——
Ash	12 12	13.09
Ether Extract	2.71	2.93
Crude Fibre	27.50	29.69
Crude Protein	13.30	14.36
N.-free Extract	36.98	39.93
Total Nitrogen	2.13	2.30
Albuminoid Nitrogen	1.50	1.62

KNOT-WEED.

(*Polygonum aviculare* L.)

Stems slender, prostrate or ascending, branching, smooth, six to fourteen inches high, from annual, fibrous roots, leafy; leaves oblong to lanceolate, one-fourth to nearly an inch long, pointed at each end, bluish-green; flowers small, two or three together in the axils of the leaves; corolla wanting; calyx with five pinkish margined sepals; stamens usually eight; "seed" (achene) triangular, dull, minutely granular, usually included in the calyx.

This weed is common everywhere in door-yards, waste places and fields. As it is an annual it is not difficult to keep in subjection. It is very hardy and grows readily on the poorest of ordinary soils, even in times of severe and prolonged drouth. A tea made from this plant is sometimes used in cases of "summer complaint" among children. All kinds of stock eat knotweed greedily. It is a near relative of the buckwheat of cultivation and is thought to be of considerable value as a forage plant by many stockmen in the Northwest. The specimens analyzed were collected on the College farm, July 14th, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.90	——
Ash	5.46	5.86
Ether Extract	2.67	2.87
Crude Fibre	18.94	20.34
Crude Protein	17.57	18.87
N.-free Extract	48.46	52.05
Total Nitrogen	2.81	3.02
Albuminoid Nitrogen	2.40	2.58

UPRIGHT KNOTWEED.

(*Polygonum erectum* L.)

Similar to the preceding but with stouter, more erect, taller (one to two feet) stems, yellowish-green color, larger, oblong or oval, obtusish leaves, and larger, flowers which are borne on more or less exserted pedicels; stamens five or six.

This is perhaps more common than the foregoing, especially in the eastern part of the state. It prefers rather moister, richer soils than that species and is a better plant for forage purposes. It may be known by its larger size, yellowish-green color and more upright habit of growth. Both of the knotweeds are often called "goose grass" and "door-yard grass," but as neither of them are at all like the true grasses these names are not appropriate. Several prominent dairymen in this and neighboring states speak very highly of this knot-weed as a milk-producing forage plant. Considering the fact that it is so hardy and yet is not likely to become a bad weed it certainly seems worthy a little more attention. The specimens analyzed were collected on the College farm on the 27th of August, 1892.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	6.82	——
Ash	5.94	5.59
Ether Extract	1.62	1.80
Crude Fibre	28.96	32.11
Crude Protein	10.27	11.39
N.-free Extract	43.39	48.11
Total Nitrogen	1.64	1.82
Albuminoid Nitrogen	1.39	1.54

Since many inquiries have been received at the Station for the analyses of millet seed and wheat bran, the following are given:

GOLDEN WONDER MILLET SEED.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	9.29	——
Ash	2.99	3.30
Ether Extract	4.51	4.97
Crude Fibre	9.14	10.08
Crude Protein	13.56	14.95
N.-free Extract	60.51	66.71
Total Nitrogren	2.17	2.39
Albuminoid Nitrogen	2.10	2.32

BROOM CORN MILLET SEED.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	10.18	——
Ash	2.33	2.59
Ether Extract	4.44	4.94
Crude Fibre	6.59	7.34
Crude Protein	13.50	15.03
N.-free Extract	62.96	70.10
Total Nitrogen	2.16	2.40
Albuminoid Nitrogen	2.16	2.40

ROLLER PROCESS WHEAT BRAN FROM SOUTH DAKOTA WHEAT.

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	8.85	——
Ash	6.55	7.19
Ether Extract	5.58	6.12
Crude Fibre	9.74	10.69
Crude Protein	18.38	20.16
N.-free Extract	50.90	55.84
Total Nitrogen	2.94	3.23
Albuminoid Nitrogen	2.57	2.82

DWARF SEDGE.

(*Carex stenophylla* Wahl.)

ANALYSIS.

	Air Dry Substance.	Water Free Substance.
Water	4.85	—
Ash	8.31	8.73
Ether Extract	3.24	3.41
Crude Fibre	22.84	24.00
Crude Protein	13.56	14.25
N.-free Extract	47.20	49.61
Total Nitrogen	2.17	2.28
Albuminoid Nitrogen	1.83	1.92

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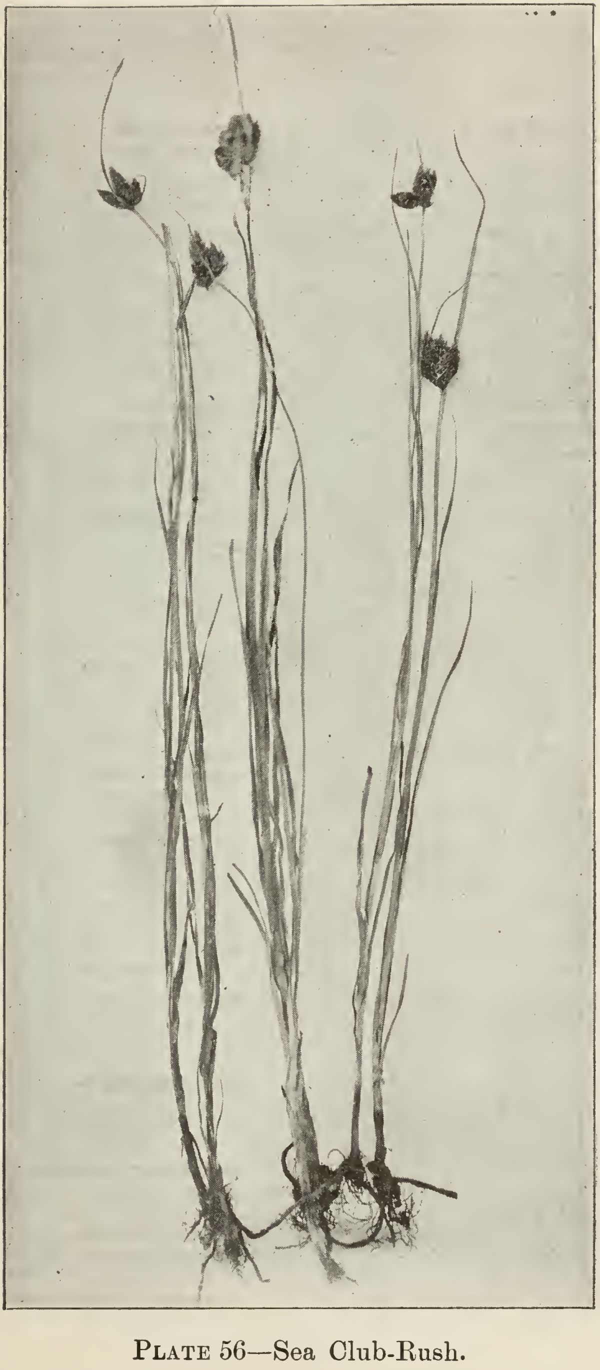

PLATE 56—Sea Club-Rush.

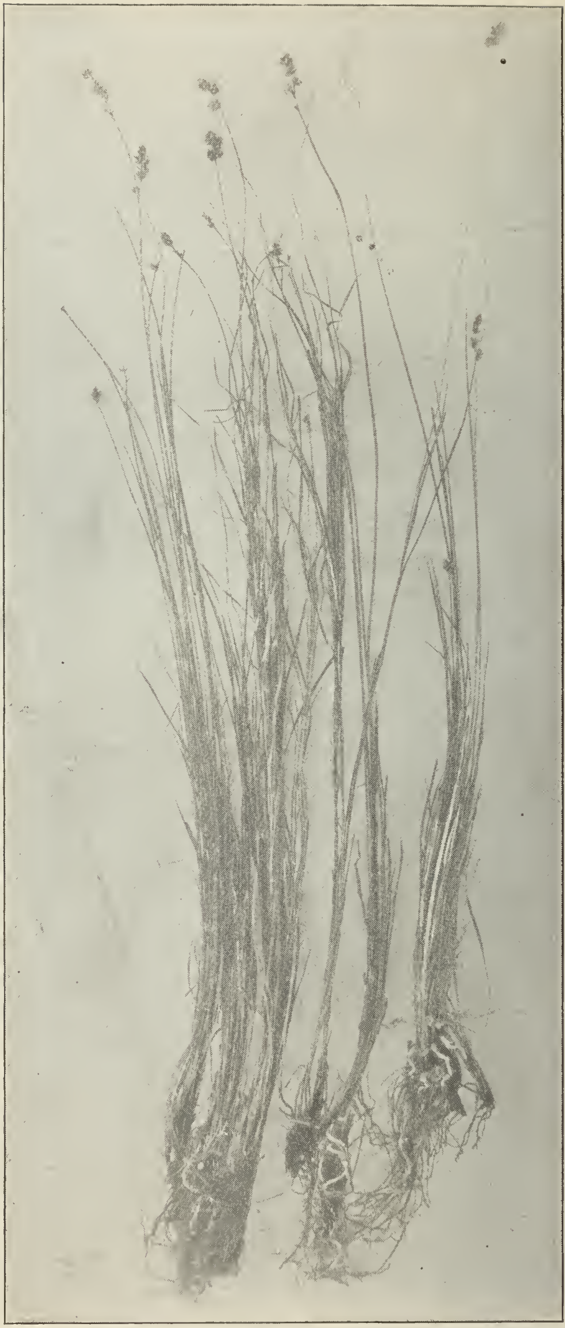

Plate 57—Straw-colored Sedge.

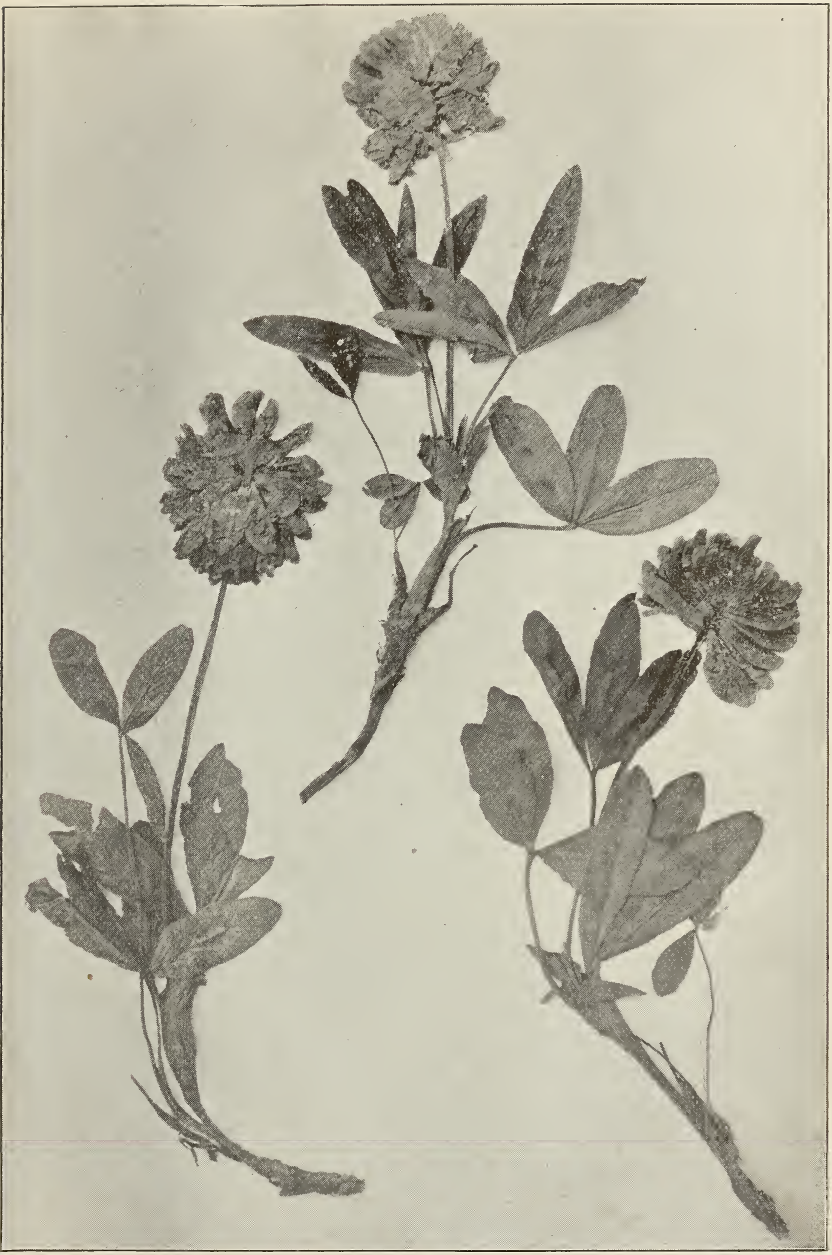

Plate 58 – Beckwith's Clover.

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